CLINICAL CONGRESS OF SURGEONS SEVENTH ANNUAL SESSION, Philadelphia, Oct. 23-28, 1916

ANNUAL SUBSCRIPTION: UNITED STATES AND CANADA, $10.00; FOREIGN, $12.00 (£2 10s.)

Volume XXXIII OCTOBER, 1916 Number 4

Surgery, Gynecology and Obstetrics

WITH

International Abstract of Surgery

EDITORIAL STAFF

FOR AMERICA

John B. Murphy, M.D.

E. Wyllys Andrews, M.D. J. Clarence Webster, M.D.

L. L. McArthur, M.D.	E. C. Dudley, M.D.	Frederic A. Besley, M.D.
A. J. Ochsner, M.D.	C. S. Bacon, M.D.	William R. Cubbins, M.D.
Thomas J. Watkins, M.D.	Carl Beck, M.D.	John C. Hollister, M.D.
Major G. Seelig, M.D.	John L. Porter, M.D.	Rudolph W. Holmes, M.D.

FOR THE BRITISH EMPIRE

A. W. Mayo-Robson, C.V.O., D.Sc., F.R.C.S.

Sir Berkeley Moynihan, M.S., F.R.C.S. Thomas W. Eden, M.D., F.R.C.S.

Harold J. Stiles, M.B., F.R.C.S. (Edin.) Henry Jellett, M.D., F.R.C.P.I.

James Rutherford Morison, M.B., F.R.C.S.

Franklin H. Martin, M.D., Managing Editor

Allen B. Kanavel, M.D., Associate Editor

EDITORIAL AND BUSINESS OFFICES: 30 N. Michigan Ave., Chicago, Illinois, U. S. A.

PUBLISHERS FOR GREAT BRITAIN: Bailliere, Tindall & Cox, 8 Henrietta St., Covent Garden, London, W. C., England

Saunders'

Books for the Surgeon

When attending the Clinical Congress of Surgeons at Philadelphia, October 23-28, Visit the Saunders Booth.

SEE PAGE 13

Entered as second-class matter Ma 3, 1913, at the postoffice at Chicago, Ill., under the Act of Congress, March 3, 1897.

Copyri t, 1916, by The Surgical Publishing Company of Chicago.

PARAGON X-RAY PLATES

At Our Expense

DOCTOR, do you fully realize the importance, to you and to your patients, of having each X-Ray plate made on any of your cases so marked that there can be no question of its authenticity? You don't know what emergency may arise to make a plate so marked a protection and a help to either or both of you. We make a "little daisy" plate marker which we send free, any name you want, with an order for a dozen Paragon X-Ray Plates—unexcelled for speed and results.

PARAGON SERVICE

The value of Paragon X-Ray Plates is in the *Service* that goes with them, quite as much as in the *Quality* of the plates.

Prompt shipment; immediate follow-up to see they reach you promptly; guaranteed plates; expert assistance in technique; advice on difficult work—in fact Paragon Service is a *practical* aid to successful radiography with a minimum of worry, work and expense. Better get all you can for your money.

To those who have never used Paragon X-Ray Plates, and who may hesitate to order a dozen for trial, we make the following Special Offer: Three each 5x7 and 8x10 Paragon X-Ray Plates (value $1.15), a 20c can of Developer and a plate marker (value $2.00) postpaid for only $1.00. Send in a dollar bill and get $3.35 worth for it, besides getting in a fair way to do better X-Ray work.

COMPARE THESE PRICES on Barium Sulphate, for use in your X-Ray department, with those you are now paying: 1 lb. 50c; 5 lbs. $1.75; 10 lbs. $3.50; 25 lbs. $7.50; 50 lbs. $12.50; 100 lbs. $24.00. Generous sample, 10c. Better investigate.

Geo. W. Brady & Co.
756 S. Western Ave.
CHICAGO

CHICAGO LABORATORY
PROMPTNESS · EFFICIENCY
CLINICAL
ANALYTICAL

The CHICAGO LABORATORY

Marshall Field Annex Building
25 EAST WASHINGTON STREET
Telephone Randolph 3610 **CHICAGO**

Pathological Tissue Examination

Surgical diagnosis on specimens of tissue may be obtained promptly by frozen section on same day specimen is received.

Send for booklet of instructions how to forward tissue and other specimens for examination.

Our names and reputations stand back of our work. Established 1904.

RALPH W. WEBSTER, M.D., Ph.D.
Director of Chemical Department

THOMAS L. DAGG, M.D.
Director of Pathological Department

C. CHURCHILL CROY, M.D.
Director of Bacteriological Department

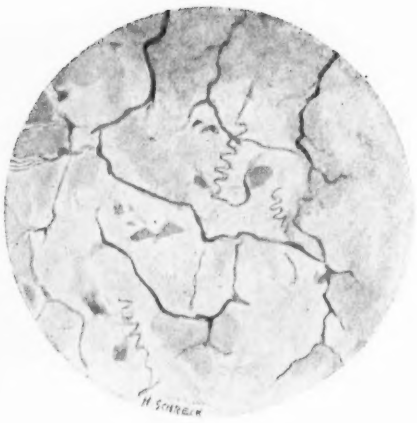


Fig. 1 (above). Case 1. Presenting vesiculo-papular elevations typically observed during acute exacerbations — associated diffuse inflammation.

Fig. 5. Case 3. Similar lesion to that in Fig. 1 but showing sharp demarcation between edge of patch and area of normal mucosa.

Fig. 3 (above). Case 2. Apparently pigmented, patchy, ecchymotic appearance seen during interval period. This case had previously shown the lesion seen in Fig. 1.

Fig. 7. Case 4. Typical of interval appearance. Two months prior to time of taking this picture this bladder had shown the most extreme type of œdema of the variety illustrated in Figs. 1 and 5.

(Frederick R. Charlton.)

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXIII OCTOBER, 1916 NUMBER 4

CYSTITIS SENILIS FEMINARUM[1]

BY THE LATE FREDERICK R. CHARLTON, M.D., INDIANAPOLIS, IND.

PERHAPS fifteen years ago I began to encounter isolated cases of a group which, I am now satisfied, is a very large and common one. Neither at that time nor more recently have I found any adequate account of it in the literature. These patients have been treated in a symptomatic way but I do not believe there has been any clear understanding of them as a group. That belief prompts this preliminary report.

In all I have seen approximately fifty cases. Most of them have been entirely lost sight of. No satisfactory case records are now available except in a few recent ones. In many no comprehensive histories or studies were ever made. The cases have occurred in my own personal charge, in consultation with other physicians, and in dispensary and hospital staff service. Because of the hopelessness of drawing any worth-while conclusions from such fragmentary records, I have abandoned that idea altogether and shall simply cite the typical history, course, and procedure, and present a few cystoscopic and proctoscopic views in color that are accurate reproductions of pictures seen in recent cases.

My observations and conclusions then are in the way of generalities, with however, some obvious and definite features. My excuse for such a generalization is simply to call attention to what I believe to be an unstudied field and to arouse discussion that may be helpful to me and ultimately to these patients.

All but one of my cases have been in elderly women, and all but one in multipara. These exceptions are included in the accompanying drawings and commented on.

If the change is a senile one, why do we not see it in the male? My comment is that I have felt that the hypertrophied prostate gives a different bent; an obstructive symptom-picture that completely breaks the parallel. Moreover, repeated childbearing with its accompanying trauma and pressure disturbances may be peculiarly a contributory cause. Certainly I have not seen the "measly" patchy injection of mucosa, a form of bullous œdema in the male bladder that prevails in these aged females.

Let me briefly cite a typical history: a woman long past the menopause, mother of several children, in reasonably good general health, comes with bladder complaint. She will most likely deny any history of bladder trouble in earlier life. The symptoms will have arisen gradually without acute onset but will persist with variable periods of comfort or distress throughout the entire life of the patient. This prognostic note implies then an essentially chronic disease. Probably a bladder once succumbing to senile atrophic changes, to which is added infections of varying types, can never be restored to better

[1] Read before the American Urological Association, St. Louis, April 17-19, 1916.

than a merely comfortable condition. Attacks will recur with lowered general resistance bad weather conditions, etc.

Its first occurrence is, as a rule, late; after sexual life has terminated. There comes a gradual recognition of undue frequency of urination with tenesmus and burning. From time to time in its course the acute exacerbations may be severe and occasion much loss of sleep and worry, resulting in distinct physical and mental impairment. Such sharp attacks may persist for weeks, followed by months of comparative comfort. The urine, at its worst, may be clouded with mucus and pus, and occasionally, though rarely, blood stained. I have never seen a urine that was grossly thick and ropy with pus and mucus, as we often see it in cystitis cases in younger individuals and in old prostatics.

The bacteriological findings have been variable and in no way consistent. Staphylococci are practically always in evidence; colon bacilli and allied forms occasionally; in one case a chain bacillus whose place in the nomenclature we never determined. Tubercle bacilli we have never found to be a factor, in spite of the sometimes suggestive appearance. The smegma bacillus was almost invariably present unless excluded by care in procuring the specimen. In short, in those cases that we have studied, a determinative infection has not been identified. It may not be a specific infection and this is our belief, but a condition developing after many differing bacterial onslaughts in bladders already weakened by the processes of senile decay. Again, many of the forms that we find may be saprophytic; there as a result of favorable soil conditions rather than as causative factors.

One of our active workers along the lines of surgical pathology suggested that I might find these cases to be secondary to various degrees of prolapse following the lacerations and relaxations of pregnancy. He thought that the prolonged air and clothing contact with perversion of secretions would in part account for the senile vaginitis and that this might be the primary source of infection, with the bladder condition secondary. Certainly in several of my more recent cases this has not been true and I am skeptical of it as definitely etiological.

One of the illustrations here shown is an extreme case in an unmarried woman of sixty-four, my only exception to the rule of the multipara. Here the vagina would only admit the little finger and there was nothing of relaxation or prolapse.

Often the bullous patches are sharply outlined in grouping from healthy perfectly normal bladder mucosa, as distinctly so as a Zoster eruption on the skin. This has suggested the possibility of its being akin to a recurrent chronic Herpes. Without going into lengthy discussion, this theory hardly appeals to me as being adequate to explain the allied changes in the rectal and vaginal mucosæ.

Almost without exception the condition is common to bladder, vagina, and rectum simultaneously. The clinical picture of senile vaginitis is so common that I shall not take time to comment on it, except to say that it is always present and recognized, that it most often receives all the attention and treatment for relief of the sometimes vague pelvic distress when it is only one of the trinity of troubles.

The vaginal change is usually looked upon as "a shrinkage of subcutaneous tissues with atrophic disturbances in the epithelium and resulting painful erosions or even ulcerations." Add to this bacterial invasion with inflammatory exudates and the future course is not difficult of imagination. If this brief paragraph is true applied to senile vaginitis, I believe it holds equally true of the accompanying bladder change and of the almost consistently present degeneration of rectal mucosa.

The vagina has not been included in the accompanying illustrations in spite of its invariable participation. I have presented, however, the rectal picture to accompany each bladder drawing. The rectal mucosa has varied in its appearance all the way from multiple punctate erosions to large distinct punched out areas of ulceration on an otherwise normal pink velvety base, but still a darker ground shade than applies to a normal bladder.

At this point the question of syphilis might

Fig. 2. Case 1. Linear area of ulceration above internal rectal sphincter — bleeding on being touched with cotton swab. Accompanies Fig. 1.

Fig. 4. Case 2. Eroded ulcerated area within rectum. History of associated bladder and rectal irritation for many years. Accompanies Fig. 3.

properly arise. I would reply that in most instances I satisfied myself from clinical evidence and history, of its absence, and in recent years have repeatedly found this view corroborated by a negative Wassermann.

The proctitis has not exactly paralleled the cystitis, there being a deeper injection and larger areas of degeneration, which variation might be accounted for in the trauma of fæcal masses and the greater likelihood of vicious mixed infections.

Autopsy has never been obtained, in as much as no death has occurred with this pathology known to be present in any case under my direct charge, and the condition of itself can hardly be regarded as even contributory to a fatal termination.

If any careful histopathological studies have been made elsewhere and are available, applying to the vaginal walls in senile vaginitis, I believe that in all essentials the findings there would correspond very closely to the rectum and bladder alike in this group of cases.

The cystoscopic appearance in two recent cases grossly presented a rather remarkable likeness to miliary tubercles, yet the elevated "measle," as I have been in the habit of calling the individual lesion, contained evidently clear serum, and one such case that I cystoscoped, years later failed to show any of this earlier appearance but did present ecchymotic areas smooth with the surface over most of the entire bladder floor and yet with a velvety unbroken epithelium. This same experience has occurred recently, to which I shall make comment in presenting the plate. One illustration here of another case would apply to that earlier cystoscopic appearance, though in lesser degree. In two of these cases cysto-urethroscopic examination revealed an extension of the same process into the urethra with reddened appearance about the external meatus.

Often the cystoscopic picture, as evidenced by the plates here presented, suggests immediately the term, *œdema bullosum*, but this term has become merely adjectival and applies to gonorrhœal involvement of the vesical neck, to mixed types of cystitis, to tuberculosis, and more rarely, to hypertrophied prostate.

The diseased condition under discussion is to my mind, however, a distinct clinical entity, where the clinical histories run in remarkable parallels and with a generally uniform symptomatology. The cystoscopic pictures vary at different times as to intensity and character, the same case in a few months ranging from an acute vesicular œdema to an almost normal bladder.

Degenerative age changes are recognized

Fig. 6. Case 3. Superficially eroded appearance in patches throughout rectal pouch. Accompanies Fig. 5.

in other mucous membranes. Bronchitis in the old becomes almost the rule. A chronic conjunctivitis with thickened and everted lids is all too common. Nasopharyngeal catarrh in the old becomes the bane of the family physician. Perhaps this bladder difficulty has simply to be added to that group.

The general management of these old women will be apparent, the best of general care and hygienic control. The usual hot boric irrigations are quickly beneficial. Argyrol in instillation is helpful. The rectal and vaginal irritation can perhaps best be met by the hot alkaline douche, the interval of douching being gauged by the comfort obtained Vigorous local treatment, such as application of strong silver, I have felt to be out of place, since the problem seems to be one more of comfortable management than of cure. Pure liquid guaiacol internally is a drug possessing almost specific properties. It almost invariably brings remarkable and quick relief from the frequency of urination with tenesmus and burning, when given in five to ten drops doses after each meal. Its use is in a way empiric. Some one has claimed that its benzoic acid radical is broken up and eliminated by the kidneys as hippuric acid. This being a normal urinary acid, may play some definite part in the relief, which we do not pretend to explain. It may be resorted to whenever discomfort is experienced and taken for indefinite weeks or put aside perhaps for many months during the intervals of comparative comfort.

To discuss cellular and tissue changes due to age decay along purely biological lines, as has been so ably done by Metchinkoff and many others, is not my province, yet I do feel that in this group of cases has been overlooked a pathological entity worthy of better recognition and a name. Tentatively I suggest *cystitis senilis feminarum*, for lack of a better.

Case 1. Mrs. W., age 69, multipara; previous health good; first experienced bladder symptoms at 64. At that time I found cystoscopically, practically the same condition as when examined recently. At this later examination Fig. 1 (frontispiece), was taken, which gives the typical patchy grouping of vesicles seen at the height of attack. She has had several long periods of complete relief during these years. Figure 2 (rectal) accompanying shows a distinct elongated ulceration just above the internal sphincter, bleeding on touch with a cotton swab.

Case 2. Mrs. C., age 70, multipara; previous health good; mild bladder symptoms presented about the age of 50. Some years later was cystoscoped, the bladder showing irregular patchy œdema. Recently, during an interval of comfort Fig. 3 (frontispiece) was taken and presents the typical pigmented appearance and chronically thickened vessel walls remaining after repeated acute exacerbations. Figure 4 shows an ulcerated eroded area in the rectum. This patient has suffered from a mucous colitis for twenty years.

Case 3. Mrs. O., age 38; mother of one child. Note that she has not menstruated since that childbirth thirteen years ago (cause unknown). During these years she has grown very heavy, until her obesity has become a burden to her. Bladder symptoms first developed nine months ago. There have been short intervals of relief. Figure 5 (frontispiece) taken during an exacerbation, shows the typical vesicular patchy lesion at the height of an attack. This is the one exception to my series, in point of age, yet here we had, years ago, an atypical or pathological menopause, so that the contradiction is after all not so great. Both vagina and rectum present superficially congested erosive areas, Fig. 6 presenting a granulated appearance of the rectal mucosa.

Case 4. Mrs. L., age 68, multipara; previous health good. At 56 slight bladder trouble first became evident with variable intervals of relief since. It has been more persistent during the last three years. January 23, 1916, she presented the most extreme cystitis of this vesiculated patchy form that I had ever seen. I brought her back March 5, to get a picture, which is shown in Fig. 7

(frontispiece). Greatly to my disappointment the appearance had entirely changed so that we were only able to get the interval picture with its apparent pigmentation of mucosa and increased network of vessels but no œdematous elevations or irregularities, as seen previously. The rectal picture fails to show any of the lesions ordinarily found in these cases.

CASE 5. Miss McN., single, age 64. This is the one exception to my experience in the factor of childbirth, but in as much as childbearing is regarded as only contributory, the exceptions may be found more frequently than I have anticipated. Previous health only fair. Bladder symptoms first appeared in February, 1915, when she had a severe attack lasting three months. Since then has had intervals of comfort.

A few of the vesicular elevations have become pustular and one large clear bleb the size of a pea is apparent. The vagina and rectum both show advanced atrophic eroded areas.

Figure 8 (rectal) shows the same vesicular lesion becoming purulent, as found in the bladder. The artist has somewhat exaggerated the purulent character of these vesicles.

Fig. 8. Papulopustules in rectum suggesting in appearance miliary tubercles. This same lesion appeared in bladder and vagina alike in Case 5.

As suggested in an earlier paragraph, the criticism may be offered that Fig. 8 is rather typical of tuberculosis. I admit the similarity but believe that during the coming summer months this bladder may be cystoscoped and will be found to correspond to Figs. 3 and 4. I have found this to be true in similar cases and bear in mind that this woman has had intervals of entire relief since the onset of her symptoms and this history does not typically coincide with tuberculosis.

SPONTANEOUS EXCLUSION OF THE KIDNEY FROM CALCULI[1]

BY CHARLES M. HARPSTER, PH.G., M.D., F.A.C.S., TOLEDO, OHIO
Surgeon, Toledo Hospital and St. Vincent's Hospital

MY case, I think, positively demonstrates that renal and ureteral lithiasis may entirely destroy a kidney insidiously, and at the same time exclude the organ completely. Such a kidney is entirely out of the urogenital system and is of no further use to the patient, and surely better out of the body than left in. If you will examine the specimen carefully you will see the ureter is entirely occluded.

The patient from whom this kidney was removed was a female 37 years of age, married, and the mother of one child. She was referred to me by Dr. H. E. Noble, on August 4, 1915. She stated at the time of examination that she had had pain on her left side since her child was born, about 12 years ago. That for four or five years she had felt a mass on her left side which was gradually getting larger. For the last three or four months she stated she had had great pain at time of menstruation and that a large amount of pus was discharged from the vagina at time of menstruation. During the summer of 1915 had had spells of chills and fever and was compelled to remain in bed a part of the time. At times the pain in the left side was very acute and at other times would entirely disappear. The urine had been frequently examined and found free from any abnormal elements. During the period of her pregnancy the urinary symptoms were very marked and when voiding urine she had a "bearing down, burning pain." I made an examination of her urine and found it normal.

I referred the patient to Dr. Dolloway for an X-ray examination, and I present the roentgenogram, in which you will see the large calculi (Fig. 1).

[1] Read before the American Urological Association, St. Louis, April 17-19, 1916.

Fig. 1. Roentgenogram disclosing large calculi.

I catheterized the right ureter on August 6, 1915, and found no urine coming from the left kidney with a catheter in the bladder, and I was unable to pass a catheter into the left ureter. The left kidney did not respond to any of the functional tests (phloridzin, phthalein, indigo carmine). The right kidney was found normal.

A few days later I removed the specimen which is shown in Figs. 2 and 3. The parenchyma of the kidney was as you see almost entirely destroyed. The cavity was filled with a caseous mass. No tubercle bacilli were found on examination.

By operation the question arises whether we deprived the patient of a possible pus focus, since the organ had been spontaneously excluded by nature (Fig. 3). Perhaps only in so far as the ureter affected the vesical function could the presence of the organ have produced any clinical manifestations and even this is open to doubt. Buerger says:

Although this process of healing or exclusion of the kidney (and, as it has also been termed "autonephrectomy") has been frequently noted as occurring in tuberculosis, it is not so well known that a similar lesion may be the result of *ureteral lithiasis* when the ureter has become obstructed for a long time. So frequent is the development of the infectious type of lesion of the kidney when a ureteral calculus is impacted for a long time in the ureter, that most of us will concede that total destruction of a kidney without pyonephrosis, without other manifestation of an infected pelvis or kidney, parenchyma, or without perirenal tissues, is exceedingly rare.

It was our good fortune to obtain at an autopsy a specimen of a kidney and ureter, which demonstrated conclusively that a kidney may be destroyed and excluded, as it were, in a silent fashion without giving any symptoms, when ureteral calculi or a ureteral calculus is impacted in the ureter for many years. In reviewing the literature but sparse mention of these facts could be found.

B. Rank[1] in an article entitled "Concerning a Case of Healed Hydropyonephrosis," describes a case of infected hydronephrotic kidney, which by virtue of an obstruction situated high in the ureter became converted into a sac, filled with cheesy, mortar-like material. The kidney was obtained at an autopsy of a man who died of apoplexy. The fœtal lobulations were fairly well marked by furrows separating many spherical protuberances, the latter varying in size from a hazelnut to a walnut. Upon section, the kidney, which was hardly enlarged, was found filled with a cheesy mass of cement-like consistency. The parenchyma was practically gone, there being hardly any renal substance left except for remnants in the membranous walls and in the connective-tissue septa. Only at one point was there a small zone of tissue, less than 1 cm. in diameter. In short the specimen denoted the following pathological history: that a hydronephrotic sac had evidently become the seat of suppurative inflammation, was thus converted into pyonephrosis, the purulent contents becoming finally changed into inspissated cheesy masses.

In discussing the causes of the hydronephrosis in this case, the author concludes that the obstruction must have resided somewhere in the uteropelvic junction, and inasmuch as no evidence of concretions or calculi were present, he believes that either an inflammatory swelling of the mucous membrane or a calculus that had subsequently passed could have brought about the condition.

[1] Virchow's Arch. f. Path. Anat., etc., Berl., 1901, clxiv, 22.

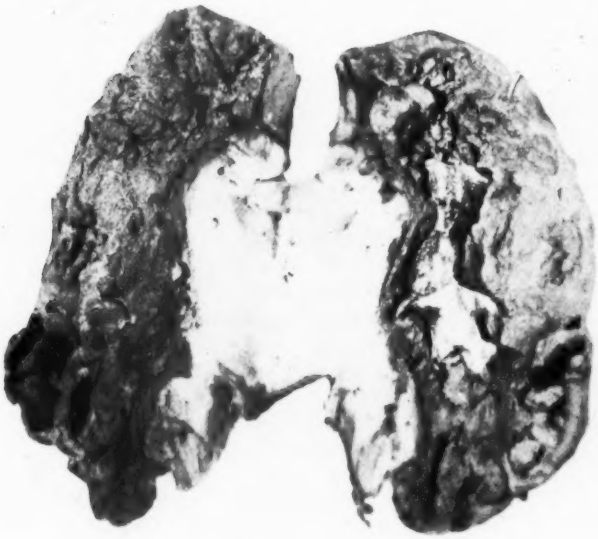


Fig. 2. Specimen removed from author's case.

Fig. 3. Specimen removed from author's case.

From a study of the author's report, it seems to us most likely that the hydronephrosis could be best explained on the basis of an occlusion of the ureter by a calculus that had been arrested for a long time but had finally been expelled. The process of renal destruction as is seen in tuberculosis of long standing where kidney tissue disappears and pseudocysts may form is often encountered where the calyx has become completely stenosed. With an obstruction of a calyx it is not frequent to see complete disintegration of the corresponding segment of the kidney and the conversion of the affected region into a sac filled with cheesy material or turbid fluid. In this way some of those cysts of the kidney may be accounted for, the pathogenesis of which has given rise to so much comment and discussion. There are those who doubt the existence of tuberculous cysts of the kidney. Heitz-Boyer, however, describes two types of tuberculous cysts: first, true cysts of the kidney, in which epithelium covers the cavities, and which coexist (renal tuberculosis); and secondly, pockets which are the result of obstruction of a urinary passage of the kidney, as where a calyx is completely occluded. If the occluded zone is healthy, a simple hydronephrosis is the result, and contents of the cavity will be clear fluid. If, on the contrary, this area be the seat of a tuberculous process, the cavity will become filled with cheesy material and this will become modified later on either into a putty-like mass, or, if the material be absorbed, into a fluid which contains some whitish particles and detritus.

DIVERTICULA OF THE URINARY BLADDER[1]

By G. J. THOMAS, M.D., Rochester, Minnesota
From the Mayo Clinic

THE frequent occurrence of diverticula of the bladder as observed in the urologic department of the Mayo Clinic has suggested a clinical study of the operative, non-operative, and post-mortem cases since 1908.

Embryology. A review of the literature and textbooks of embryology as to the early development of the bladder is confusing. Many of the early writers are of the opinion that the anlage of the bladder is a differentiated portion of the allantois and is derived from this structure. Later writers, however, hold that the bladder is formed from the cloaca, a blind sac which is a dilated portion of the primitive gut, caudal to the allantois. The cloacal membrane probably divides this sac into a ventral or large portion which becomes the urogenital sinus, and a dorsal smaller portion which becomes the rectum. Prentiss (1), however, from his dissections thinks that a saddle-like partition between the primitive gut and allantois grows caudally and divides the cloaca into dorsal rectum and a ventral primitive urogenital sinus. The partition thus made fuses with the cloacal membrane and divides it into the anal membrane of the gut and the urogenital membrane of the urogenital sinus. The mesonephric ducts which opened into the cloaca now open into this sinus. The buds forming the ureters spring from the mesonephric ducts near their insertion into the cloaca. As the urogenital sinus gradually becomes separated and differentiated from the rectum, certain absorptive changes take place in the proximal ends of the mesonephric ducts and primitive ureters. They become dilated, are taken up into the wall of the sinus, and as the absorption continues the ends of the ureters develop a separate opening and become separated from the ducts. The area between the ends of these two sets of ducts later becomes the point of division between a larger cephalic part of the sinus or the anlage of the bladder and a smaller caudal portion which becomes the urethra.

Etiology. The etiology of these sacs from an embryologic standpoint can probably be explained as follows: The diverticulum so frequently seen around the meati may be anomalies of mesonephric duct buds which normally form the ureters, etc., as Cabot and Binney pointed out from Huntington's case. Since portions of the wolffian ducts are taken up into the bladder and form a portion of it, anomalies of development may occur along the trigone and floor of the urethra as far as the ejaculatory ducts. The mucosa of the bladder is largely endodermal in origin except the trigone which together with the floor of the urethra is mesodermal. The failure of the urachus to close may account for some of the sacs at the roof of the bladder. These observations indicate that anomalies of embryologic development may at least predispose to the formation of these diverticula since most of them occur where fusion takes place between the different embryonic tissues. The location of the openings is most often in the areas where anomalies may be expected. The rôle that obstruction plays in the formation of these anomalies is not clear but clinically in a large percentage of cases it seems necessary for the development of symptoms.

Diverticula may be divided into two groups, congenital and acquired.

1. The congenital may be divided into (a) hour-glass bladder, the strangulation may be above or below the ureters; (b) double, split or bifid bladder. In this type the separation reaches to the apex of the trigone and both cavities open into a common urethra, or a double urethra may be present.

2. The acquired type may be divided according to their etiology into (a) intra-uterine; (b) obstacles to urination (most frequent); and (c) traumatic.

The true congenital variety as observed

[1] Read before the American Urological Association, St. Louis, April 17-19, 1916.

clinically is a deformed bladder; e.g., the hour-glass or the septum bladder, probably the result of maldevelopment. Obstruction or infection seems necessary to bring about symptoms in this group, although in the few instances observed in young people there was no obstruction nor was there a history of infection which might have caused a temporary obstruction. The walls separating the spaces in these deformed bladders are thick and contain all the coats of the bladder. Other genito-urinary malformations are usually found with this type as bicornate uterus, double vagina, etc.

Some observers believe that the bladder in intra-uterine life is subjected to temporary obstruction which weakens certain areas of the wall without causing sacculation. During life these weakened areas quickly dilate or sacculate after obstruction is present. In this type there is congenital predisposition but an acquired etiology. The *truly acquired* variety is the many-pocketed bladder having demonstrable, long-standing obstruction with or without infection. The traumatic cases probably belong in this group and obstruction may or may not be an etiologic factor; the bladder after trauma to its coats may herniate into any cavity which offers little resistance.

Englisch (2) holds that all diverticula having a muscular coat are congenital, while those with a mucous coat only are acquired. In our cases the walls of the diverticula were not easily examined and we were unable to make a classification on this finding. Englisch further says that all diverticula are associated with some obstruction to outflow, either intra-uterine or during life. Ali Krogius (3) quoting Pagenstecker, explains the latent development of symptoms on a mechanical basis and thinks the view of Englisch prejudiced. He says that the innervation of the diverticulum being the same as that of the bladder, the diverticulum has to work against the pressure of the full bladder when trying to empty itself. Because of this added work the musculature of the diverticulum hypertrophies. As long as the musculature remains adequate and does the work, there are no symptoms; when, however, the hypertrophy cannot go on, the urinary act is not complete and symptoms develop. Dilatation begins with possible displacement of the neck of the bladder from which obstruction of any grade may develop. Buerger (4) observed a case in which the contraction of the neck of the diverticulum was so great that a small cautery wire could not be passed into it. This was attempted because there was a papilloma within the diverticulum. At a previous examination the diverticular opening was easily seen and was of fair size. The muscle-tissue seemed well developed in the diverticular neck. Rokitansky (5) is of the opinion that diverticula are found only in bladders having hypertrophied walls and that the mucosa is forced between the muscle-bundles; the opening is at first slit-like and then rounded. Interstitial changes in the muscle-bundles cause uneven resistance which invites sacculation. Chute (6) concludes that diverticula are formed from the pits which are situated on the outer side of the ureter and to this predisposing factor must be added increased pressure before a diverticulum is formed.

Cabot (7) calls attention to a case observed by Huntington and reported by Binney, that showed a bud from the bladder which originated at the usual site of the left ureter. This was a case of congenital absence of kidney and ureter and the bud was found on the deficient side. Cabot is of the opinion from this case that diverticula probably originate from congenital buds which do not go on to ureter formation, but form the small sac which we know as a diverticulum. Cabot thinks that hernial protrusions in obstructive cases are not diverticula. He confines the word diverticulum to those pouches always of congenital origin occurring most frequently in certain localities of the bladder, but occasionally seen in almost any portion and not due to defective development or lack of closure of any recognized structure.

One of our cases may be similar to the one reported by Binney.

The patient came to the Clinic because of pyuria and pain in the right kidney-area. The patient did not speak English and a good history was not obtained. A functionless pyonephritic right kid-

Fig. 1. Small diverticula, probably congenital.

ney containing stones was diagnosed from roentgen and cystoscopic findings. About one-half inch anterior to the right orifice and toward the median line was another opening which could admit the end of the small finger. Upon observation apparent spurts of fairly clear urine could be seen but these seemed to be synchronous with respiration. A catheter was passed with apparent ease and did not feel as if it coiled up. Argyrol was injected into the bladder and a cysto-ureterogram was made. This showed a sausage-shaped shadow extending from the bladder to the bony pelvis of the right side where it was lost (Fig. 1). A shadow-casting catheter was passed into the right ureter which was found in a normal position and did not empty into, or have any connection with the anomalous cavity. This patient had had a pelvic operation in which trauma of the bladder may have occurred and which might have been the etiologic factor in producing the sac.

In the diagnosis of diverticulum of the bladder in patients having suggestive symptoms, Garratt (8) makes it a practice to distend the bladder with an opaque medium. He believes that the diagnosis can easily be made by this means, and that it should be used routinely, because in many instances cystoscopic findings are not positive.

In operating on a case of hour-glass bladder, Squier used two large clamps through the diverticulum opening and by resection between the clamps and stitching up the cut edges a large bladder or sac was made. He does not recommend this operation in all cases, but thinks it applicable when the diverticulum is of the hour-glass type.

In Young's (9) case in which there was a papilloma, he used a circular incision made from the vesical side surrounding the opening of the diverticulum. By blunt dissection the surrounding tissues were dissected off and it was necessary to remove a piece of the peritoneum. The peritoneum was closed through the vesical opening. This method is suggested by Young to remove diverticula and tumors which are situated on the posterior wall of the bladder and behind the ureteric openings.

Lower (10) suggested the introduction of a gauze strip into the sac to simulate a semi-solid tumor which makes its size easily seen and facilitates its removal. Edwin Beer (11) suggests the introduction of catheters into the ureters before operation is begun so that the ureters are easily found and constantly in view especially where transplantation is to be done.

Lerche (12) by means of a rubber bag attached to the end of a catheter and distended after introduction into the neck, both increases the size of the diverticulum and makes resection easy. Lerche reports the following routes for radical operation.

A. Vaginal route.
B. Sacral route.
C. Suprapubic intraperitoneal.
D. Suprapubic extraperitoneal.

The various simpler methods which are used are:

A. Incision through the vaginal wall and drainage.
B. Establishing of fistula by sewing to the skin.
C. Peritoneal drainage behind bladder.
D. Peritoneal drainage of bladder.

Fig. 2. Large diverticula in the right wall of the bladder. Shadow projecting on that of the bladder.

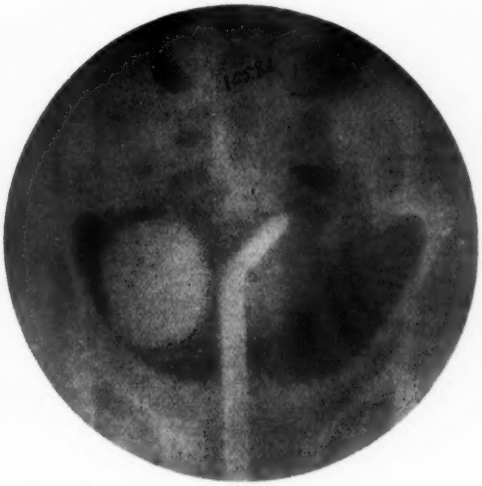


Fig. 3. Shadow showing a diverticulum which had been carefully injected with argyrol through an ureteral catheter. Argyrol not allowed to pass into the bladder.

E. Forcible stretching of the orifice of diverticulum.

F. Curettement of mucous membrane of the diverticulum and suture of the latter without drainage.

G. Invagination of diverticulum and bladder, freshening of the margin of the orifice and closure intraperitoneally.

H. Enlargement of the orifice of communication between the diverticulum and the bladder or a new anastomosis.

I. Division of the walls of the bladder and diverticulum and suture of the cut walls.

J. Suprapubic drainage.

Englisch (2) reports fifty-seven cases of diverticula up to 1904 in which there was perforation or rupture. He divides the cases that are most liable to perforation or rupture into four classes. (1) Chronic type with accumulation of pus and mucus, (2) acute suppurative, (3) ulcerating and gangrenous, and (4) perforating. In his opinion the location of the opening of the diverticulum in the bladder and its size are important factors entering into subsequent inflammation, perforation, etc.

In cases collected by Fischer there was a mortality in operative and non-operative cases of 66.7 per cent; in operative cases 40 per cent and in non-operative of 84.3 per cent.

From January, 1908, to November, 1915, twenty-seven cases of diverticulum of the bladder have been observed in the Mayo Clinic. Fourteen of these patients were operated on; seven were not operated on, and six cases were found at autopsy. The average age of these patients was 51+ years; the youngest 18, and the oldest 73. The average age at onset of symptoms was 43+ years. Other than these, numerous cases were observed which were regarded as false diverticula, probably the result of mechanical obstruction or inflammatory changes. These cases are not included in this report.

Previous diseases. Of these twenty-seven patients, six (22 per cent) gave a history of urethral infection and two (7 per cent) had infection about the urethra associated with stricture. Five patients (18 per cent) had had previous operations, two for prostatic obstruction, and three some operation on the bladder for drainage or exploration. Six (22 per cent) had trauma of the bladder, suprapubic area, or of the perineum. The trauma to the perineum in two cases was the cause

of obstruction which preceded the symptoms. The four remaining patients gave good histories of onset of symptoms immediately following the trauma of the bladder.

Urinary symptoms. Difficulty of urination was present in nineteen instances (70 per cent) and was noted in eleven (40 per cent) as the first symptom. In nine there was retention and catheterization had to be resorted to before urine could be passed. In three there was incontinence. Frequency was a first symptom in nine (33 per cent) and was the predominate symptom in twenty-two. Hæmaturia was the first sign observed by the patient in two instances (7 per cent) while macroscopic blood was observed at some time during the history in eight (29 per cent). We were able to obtain a history of repeated urination from one patient only, a symptom which has been frequently noted in published reports. In only two of our patients the symptoms began in childhood.

Clinical data. A suprapubic tumor was palpable in only three cases (11 per cent); in none was a flank or rectal mass observed. In eleven cases (40 per cent) a noticeable loss in weight was reported and this seemed to be the most common clinical finding. In six (22 per cent) the general loss of strength was graded as three on a scale of four.

Cystoscopic data. Cystoscopic examinations were made in nineteen of our patients. In sixteen (84 per cent) there was a marked degree of cystitis. In three (15 per cent) cancer was found in the bladder. In one case at post-mortem a cancer was found in the diverticulum and was the cause of a perforation. Stones were found in the bladder in four (21 per cent); in one they were found with a cancer. There were three cases with multiple small stones in the diverticulum. Urethral stricture was noted in three (15 per cent) and was thought to be an etiologic factor in the production of the diverticula. In eight (42 per cent) the prostate was enlarged enough to cause obstruction to urination.

Location of opening of diverticulum. The opening of the diverticulum was found near the meati in six of the twenty-seven patients, on the right side in two, and on the left in four. In six others the opening was found on the floor of the bladder; in two near the urethra; in four on the posterior wall; in two in the dome; in three the lateral walls were involved; in one an hour-glass condition was found. In the three remaining cases the opening was on the posterior wall or base. In four cases there was more than one diverticulum. In thirteen cases generalized trabeculation of the bladder was present.

Roentgen-ray. A cystogram was made in sixteen cases, ten showing positive findings. In our opinion a routine cystogram in suspected cases in which there is difficulty of urination not otherwise diagnosed either with or without the aid of the cystoscope will demonstrate a diverticulum in a large percentage of cases. Care must be taken in exposing the plates. Many shadows of diverticula are missed when the radiogram is taken in the ordinary anteroposterior position. Exposures should be made with the tube at different angles so that the shadow of the sac is not superimposed on that of the bladder. A coiled shadow-casting catheter or bougie will definitely outline a sac when shadow-casting fluids cannot be used. Care must be taken in the introduction of catheters into these sacs, and overdistention from injected fluids must be avoided because perforation of the diverticulum might occur (Figs. 2, 3, 4, 5, and 6).

Urinalysis. Pyuria was present in seventeen cases and gross blood was noted in three.

Medical treatment. Symptomatic treatment does not relieve patients of their symptoms and should be used only when surgical measures are contra-indicated. Temporary relief is sometimes obtained but recurrence is sure.

Surgical treatment. In fourteen cases some type of operation was performed. In six the diverticulum was resected. The extraperitoneal operation was done four times and the intraperitoneal two. A preliminary drainage was done in two cases preparatory to a resection. In six instances a drainage operation only was done or the diverticular opening was enlarged. In one case a septum was removed and in one a diverticulum was

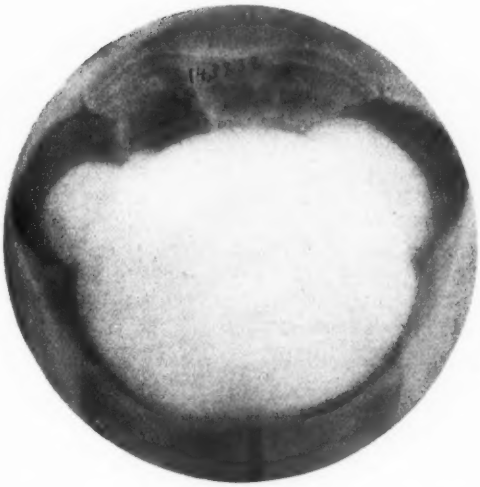


Fig. 4. Multiple diverticula in the lateral walls of the bladder.

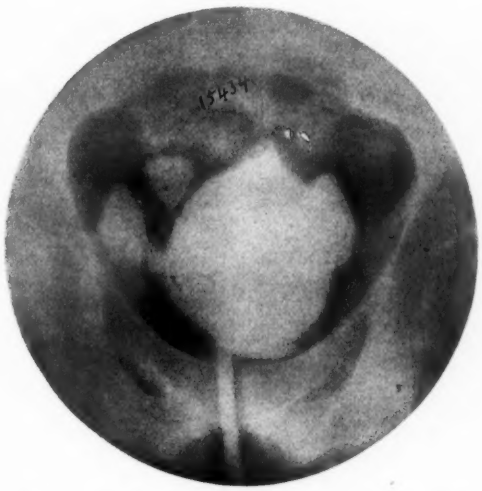


Fig. 5. Multiple diverticula in the lateral walls of the bladder.

dissected loose and its opening enlarged so that the drainage was improved or complete.

Complications. In three instances cancers were removed, one occurred with an hour-glass contracture of the bladder, the mass in the upper chamber. Stones were removed in three patients, two having stones in the diverticula. It was necessary to remove the prostate in six instances. The prostates all proved to be benign. Dilatation of the ureter was found in one. In only one case was there evidence of perforation or of peritonitis.

This occurred in a man of 70 years who came to the Clinic complaining of a long-standing skin-trouble. For a number of years he had slight difficulty with urination and was quite sure that he was not emptying his bladder. He was in very poor physical condition and a complete examination was not made. Urinary difficulty became so troublesome that he was confined to his bed. He had a sudden attack of pain in the lower abdomen, increase in temperature and pulse rate, and collapse. He seemed to pass a fair amount of urine, and catheterization was not done for fear of precipitating an attack of uræmia which was the tentative diagnosis. He died in 4 or 5 days before a positive diagnosis had been made. At autopsy a moderate degree of hypertrophy of the prostate together with three diverticula were found. One of the diverticula had ruptured because of a cancer which it contained. The diverticulum was situated along the posterior wall of the bladder.

Evidence of peridiverticulitis with resultant adhesions was present in every patient. The difficulty of removal in most instances made a careful examination of the diverticulum impossible. In three patients persistent post-operative fistula developed which did not heal for several months. Pyelonephritis was a complication in four; stone with pyonephrosis in one. In one instance only did the ureters open into the diverticula and the condition was bilateral.

Mortality. In the six cases in which resections were done, there were no deaths. One of these patients died some weeks after leaving the hospital, probably from acute renal infection. Two patients had drainage preparatory to resection; one of these died. One other had a carcinoma in an hour-glass bladder and died after suprapubic drainage. In one case in which there were large stones in an enormously distended bladder with a diverticulum, the patient died from the effects of suprapubic drainage. In six instances a diverticulum was discovered at autopsy; one of these patients had had a severe renal infection; one had had a few pus-cells in the urine; in the remaining cases there were no urinary findings. These patients did not have symptoms which could make a diagnosis of

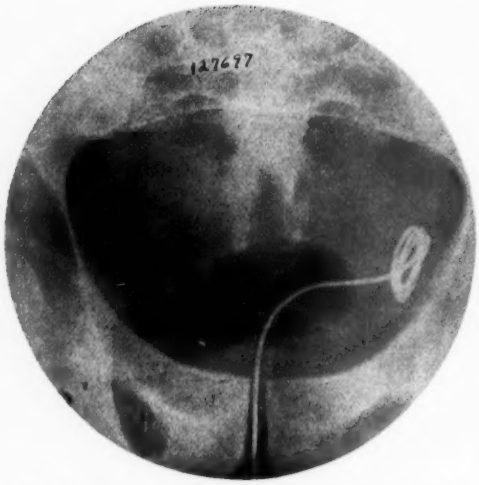


Fig. 6. Shadow-casting catheter carefully coiled in a diverticula in the left lateral wall of the bladder.

diverticulum probable, except the one with renal infection. In the cases complicated by carcinoma, stones or severe renal infection, the mortality is high.

Post-mortem findings. A review of the post-mortem findings shows some interesting facts. Marked pyelonephritis was found in 80 per cent and was considered the major factor in causing death. A severe grade of nephritis was found in 78 per cent. In 55 per cent there had been severe cystitis and in two the inflammation in the diverticulum was more marked than that in the bladder. Two patients died of pneumonia.

CONCLUSIONS

1. The embryology of the bladder is not clear and in only a few cases does incomplete development account for the pathology. In some instances the condition may be congenital, but other factors seem necessary before symptoms develop.

2. In this group the average age of onset (43+ years) would indicate that acquired factors (obstruction 86 per cent) seem necessary for the development of diverticula clinically.

3. Trauma was a factor in 22 per cent.

4. The cystogram and leaded catheter are of great aid in diagnosis and may be the only positive findings.

5. Surgery is the best method of treatment. The choice of operation depends on the location and size of the diverticulum.

6. When resection is possible, the mortality is negative. In complicated cases the mortality is high because of renal and vesicle infection.

REFERENCES

1. Prentiss, C. W. A Laboratory Manual and Textbook of Embryology. 1915, 213.
2. Englisch, J. Isolier Entzuendung der Blasendivertikel und Perforationsperitonitis. Arch. f. klin. Chir., 1904, lxxiii, 1.
3. Krogius, A. Contribution to our knowledge of the so-called congenital diverticula of the urinary bladder and their treatment. Urol. & Cutan. Rev., Tech. Suppl., 1913, i, 142.
4. Buerger, L. Congenital diverticulum of the bladder with a contractile sphincteric orifice. Urol. & Cutan. Rev., 1913, xvii, 135.
5. Rokitansky, C. A Manual of Pathological Anatomy. 1855, iii, 48.
6. Chute, A. L. Two cases of diverticulum of the bladder treated by operation. Boston M. & S. J., 1912, clxvii, 316.
7. Cabot, H. Some observations upon diverticula of the bladder. Tr. Am. Ass. Genito-Urin. Surg., 1913, vii, 62.
8. Garratt, J. M. Diverticula of the urinary bladder, with special reference to roentgen-ray diagnosis. Surg., Gynec. & Obst., 1911, xiii, 292.
9. Young, H. H. Report of a case of vesical diverticulum containing a cancer. Tr. Am. Ass. Genito-Urin. Surg., 1909, iv, 121.
10. Lower, W. E. An improved method of removing a diverticulum of the urinary bladder. Cleveland M. J., 1913, xiii, 1.
11. Beer, E. Transperitoneal resection of a diverticulum of the bladder. Ann. Surg., Phila., 1913, lviii, 634.
12. Lerche, W. The surgical treatment of diverticula of the urinary bladder; with the report of a case and a new device for facilitating the operation. Journal-Lancet, 1912, xxxii, 337.

THE TREATMENT OF GENITAL TUBERCULOSIS IN THE MALE[1]

By JOHN H. CUNNINGHAM, Jr., M.D., F.A.C.S., Boston

THE material upon which this communication is based is from the post-mortem and clinical data of the Boston City Hospital; the Long Island Hospital, where there is a large tubercular camp; private cases; and a survey of the literature.

Post-mortem findings have been included, first, because examinations at autopsy are more accurate than clinical observations, and serve to establish the frequency of co-existing tubercular lesions in the different structures of the genital tract; second, because it is frequently impossible to detect clinically the presence of tubercular lesions in the prostate and vesicles when tuberculosis of the epididymis is obvious; third, because in tubercular epididymitis it is of great importance to know the probability of similar lesions in the other organs of the genital tract, when they are apparently normal by every means of clinical examination; fourth, it is of great value to know the frequency with which renal and vesical tuberculosis is to be expected, together with tuberculosis of the epididymis; and fifth, it is possible by post-mortem examination to learn how frequently other organs, such as the lung, bone, etc., are tubercular also. Such information, it seems to me, must be the groundwork upon which our inaccurate clinical methods of observation stand, and it is from the actual knowledge, or if not actual knowledge, the likelihood of the presence of the infection in the remainder of the tract, that appropriate treatment should be based.

Autopsy findings. In 4250 autopsy records I have been able to find 35 instances of *tuberculosis of the epididymis*, the most common lesion of the genital tract to be observed clinically, in which a microscopical examination as well as a gross description of the condition of the prostate and vesicles is recorded. Of these 35 cases, the disease was bilateral in the epididymis in 15, and in 20 it was unilateral—right 12, left 8. In these 35 cases the vesicles were involved in 25, and the prostate in 25. It is seen that in each instance where the vesicle was involved the prostate was involved also, and that there were 10 instances where the epididymis was the only structure of the tract affected; which gives good reason for the belief that the disease is usually primary in this organ. Of the 15 bilateral cases, involvement of the seminal vesicles was bilateral in 11 and unilateral in 4. Of these 35 cases the testicle was involved in 19. In 4 of the cases involving the epididymis, vesicles, and prostate with a caseous tuberculosis, there was an acute miliary tuberculosis of all the visceral organs which was the probable cause of death. In all of the other cases the primary cause of death was other than tuberculosis of the genital organs. In many of these instances of tuberculosis of the epididymis just mentioned the lesions in the prostate or vesicles were not, and, in fact, could not be detected by rectal palpation; because in some it was only on microscopical examination of the tissues that the lesions were detected.

Of these 35 cases the bladder was involved 16 times and the kidney showed unilateral tuberculosis in 11 and bilateral infection in 5. Tuberculosis of other structures occurred as follows: lung, 31; bone, 5; intestines, 8; ischiorectal abscess, 3; some of the cases showing multiple lesions. In this series of 4250 autopsies there were two instances of caseous tuberculosis of the prostate without involvement of the vesicles or epididymis. In one there was no other focus of tuberculosis in the body, except in the lung; and in the other both kidneys and the bladder were tuberculous, and at the same time there was a lung focus.

Clinically, an analysis of the cases of tubercular epididymitis serves to substantiate the post-mortem findings in some degree, but the discrepancies in demonstrating the high relative co-existence of the disease in the different organs of the whole tract, from the clinical data to follow, must be attributed as previously stated, to the inability to dem-

[1] Read before the American Urological Association, St. Louis, April 17-19, 1916.

onstrate the lesions, clinically, as frequently as they exist.

Of 86 patients showing a tubercular epididymis, where the records are satisfactory, 41 showed palpable lesions on the vesicles and 49 in the prostate, while 37 showed no palpable lesions in the vesicles or prostate.

In many of the instances where the vesicle and prostate were typically tubercular, smears of the material expressed from them showed the tubercle bacillus in less than 15 per cent of the cases examined.

Of these 86 clinical cases the bladder and kidneys were examined in 51. The bladder was tubercular in 16, there was unilateral renal tuberculosis in 9, and bilateral in 5, and in 2 no renal tuberculosis could be demonstrated. In three cases there was a tuberculosis of the hip and 5 had Pott's disease; one had tuberculosis of the shoulder-joint; and 67 had distinct signs in the lungs.

A consideration of the literature, both post-mortem and clinical, adds further evidence which leads one to the conclusion that tuberculosis of the genital tract in the male, is most common in the epididymis, where it is often primary, occurring as a hæmatogenous infection, and from the epididymis the disease extends along the vas, either by continuity or lymphatics to the vesicles and prostate. Walker, in his remarkable monograph, *Studies in the Experimental Production of Tuberculosis in the Genito-urinary Organs*, states that secondary tuberculosis of the vesicles occurs in about 60 per cent of all the cases of genito-urinary tuberculosis, and as shown in my post-mortem findings when the vesicles were involved the prostate was involved also (25 out of 35 cases).

There is much evidence to support this view. Simmonds found in a series of 35 cases of genital tuberculosis that the vesicles were infected in 29 and the prostate in 26. Oppenheim in a series of 27 cases found the vesicles invaded in 17 and the prostate in 18. Krzywicki in a series of 15 cases showed the vesicles tubercular in 11 and the prostate in 14. Collinet in a series of 70 cases found the vesicles involved in 36 and the prostate in 44. Saxtorph, in a series of 547 instances of genital tuberculosis found at autopsy, records but two instances where the only demonstrable lesion was in the vesicles and 9 cases where the only lesion was in the prostate. Teutschlaender, in a series of 57 cases found but a single example of tuberculosis confined to the vesicles. Guisy in a series of 183 cases of genital tuberculosis found but 10 involving the prostate and vesicles alone. Socin and Burckhardt record 44 clinical cases of genito-urinary tuberculosis and found no instance where but single structure was involved.

The question of whether tuberculosis occurs as a primary lesion in the prostate or vesicles as far as the genital tract is concerned is of only passing interest. As regards the prostate it must be considered extremely rare, but an autopsy record by Crandon and two by Krzywicki and the two cases in my series, show that the prostate may rarely be the only organ of the genital tract to be infected. In regard to the vesicles, the autopsy findings of Saxtorph, Teutschlaender, Oppenheim, Orth, Dreyer, and others must lead to the belief that this structure may be the only one of the tract to harbor tuberculosis; yet the vesicles, like the prostate, are usually infected from a tubercular process in the epididymis or kidney. From this evidence it is not to be presumed that when the vesicles give clinical signs of a tubercular process, these structures are the only part of the genito-urinary tract involved.

It may be safely concluded, therefore, from the post-mortem and clinical data, that when tuberculosis is present in the epididymis, there are tubercular lesions in the vesicles and prostate in most instances, whether they can be demonstrated clinically or not.

Treatment. It is upon this well-founded assumption that treatment should be based. There are those who, recognizing lesions in all the different organs of the tract, recommend and have practiced a total removal of the genital tract. On the other hand there are those who, recognizing the same condition, advocate no surgical procedure, but rely on general hygienic measures, symptomatic treatment, and tuberculin. Between these two extreme points of view we have

those who advise simple drainage of tubercular abscess or removal of the scrotal lesion either by epididymectomy or castration, leaving the disease in the vesicles and prostate, kidney and bladder, as the case may be, to be taken care of by reliance upon the improvement in general condition, after the removal of the scrotal focus, followed by employing hygiene, tuberculin, or both, to immunize the individual against further outbreaks of the disease. As has been pointed out, tuberculosis of the upper urinary tract may be associated with the genital tuberculosis in some instances, and a knowledge of the condition of the bladder and kidneys should be ascertained, if possible, by cystoscopy, ureter catheterization, and renal function tests before the method of treatment should be decided upon, and if a complete examination of the upper urinary tract is impossible, at least a catheter specimen should be subjected to urinalysis and bacteriological study. It is obvious that a complete knowledge of the individual case is of value in prognosis and must influence the course of procedure in the treatment. Naturally a patient with tuberculosis of the whole genito-urinary tract or advanced phthisis should not be treated surgically, except in a palliative way.

Before proceeding to elective surgical operations upon the genitals, it is essential to have, besides a complete knowledge of the genito-urinary system, the evidence furnished by a general physical examination; for it has been shown that tuberculosis of the urogenital system is always to be considered secondary to a tubercular process elsewhere in the body. It is only upon a complete knowledge of the individual case that appropriate treatment can be instituted.

It must be clear that the problem of treatment must be considered as one of immunization, for, with the presence of tubercular foci in different organs of separate systems of the body, no surgical procedure can entirely free the patient of the disease as such. All evidence in regard to the surgical treatment of tuberculosis points to but one conclusion; namely, that surgical treatment does not in itself fulfill all the indications, and localized tuberculosis in the genital system, as elsewhere, should therefore not be considered as a purely surgical problem, but rather that surgery may be a valuable method of freeing the bodies of accessible foci, that the natural immunizing function of the body may be improved and other immunizing measures may be more effective.

In regard to what may be expected from surgery as applied to genital tuberculosis, there is no report as complete as that by Barney. He has shown, from a study of 154 cases of genital tuberculosis at the Massachusetts General Hospital, that tuberculosis was demonstrated clinically in other parts of the body in 55.8 per cent of the cases (lungs, 35 cases; kidney, 7 cases; bones, 7 cases). Of these 154 patients he was able to trace 113, and found that 31 died of tuberculosis and 8 from other causes. Of the 31 patients dying of tuberculosis 15 developed signs of tuberculosis elsewhere in the body following operation. Of these 31 cases, 4, or 14.2 per cent, died in the hospita within a month after operation; 9, or 32.1 per cent died within 6 months; and that within one year, 50 per cent had died. At a period of six years after operation 85 per cent had died.

The results obtained by the attempt to remove the whole genital tract are not at hand, except those of Whiteside's, who in 1914 reported 22 cases of removal of the whole or one-half of the genital tract, that is the testicle with the epididymis, the vas, seminal vesicles, and prostate. In that series he considered 4 cured, "9 died or phthisis" (time after operation not stated), "3 died within a few months from local infection," 6 were lost sight of, "presumably they may be dead." There was no operative mortality. The time required to do the operation was about three hours.

Personally, I have recognized the advantages of a total extirpation of the genital tract in suitable cases, because of the associated tubercular lesions in other parts of the genital system, yet the technical difficulties entailed in performing this operation several times, upon the cadaver, have kept me from employing it in the living.

The most complete report of cases followed

for many years, that I can find, is by Haas. He records the results of the Tuebingen clinic of Bruns, which follows: 111 patients, upon whom either single or double castration had been performed, were examined at periods subsequent to the operations, varying from three to thirty years. In 78 of the cases, one testicle, and in 33 of them both testicles were removed. The vas was divided high up in all cases. In 26 per cent only of the unilateral castrations did the disease appear in the other testicle later, but 9 per cent of the same patients died of tuberculosis of the urinary tract. Most of the latter number had shown evidence of tuberculous disease of other parts of the tract previous to the operations. Cure followed the unilateral castrations in 44.6 per cent of the cases. Of the 33 patients who were submitted to double castration, 56 per cent were cured, 15.6 per cent died within the first three years afterward, from genito-urinary tuberculosis in some form or other. The mortality, therefore, of complete castration within the first three years after the operation was nearly twice as great as that seen in connection with the unilateral operation in the same period; but, on the other hand, the percentage of cures among the patients upon whom complete castration had been performed, and who survived more than three years afterward, was noticeably greater.

The procedure of removing the scrotal focus, either by epididyectomy or castration, with subsequent hygienic treatment, and in recent years by employing tuberculin, is today the most common practice. Barney's report, the most recent and complete in regard to end-results, showing a mortality of 85 per cent within six years following such procedures in an institution of the highest surgical efficiency is far from satisfactory.

There is much evidence in support of the benefit which may be expected by the employment of hygiene and tuberculin. I have recently examined several cases who have been under the care of Dr. George Sanborn, director of the Department of Vaccine and Serum Therapy at the Boston City Hospital. I am convinced that much benefit has resulted in the cases which have been treated by tuberculin subsequent to the removal of local genital foci, and there are two cases with which I have been personally familiar, that from all objective and subjective signs may be considered free from tuberculosis in the genito-urinary tract without any previous surgical procedures. One is a young man seen in 1907 by Dr. John T. Bottomley. A diagnosis of tuberculosis of the right kidney was made by ureter catheterization and inoculation tests, and there was a characteristic unilateral genital tuberculosis. An abscess developed in the scrotum from which the tubercle bacillus was isolated. After 18 months, treatment by tuberculin the symptoms were entirely absent and two years ago, 1914, inoculation tests of the urine were negative.

Another case, a man 24 years old, had a unilateral genital tuberculosis, resulting in abscess formation in the scrotum. After 6 months' treatment with tuberculin the wounds were healed and there were no subjective symptoms. This patient was seen on March 26, 1916. The testicle and epididymis were practically destroyed leaving a small fibrous body. There was a hard nobule in the left lobe of the prostate, and the left vesicles had somewhat thickened walls, but not enlarged. The material expressed was not abnormal and inoculation tests of the urine were negative, and no organisms could be found in smears. There are many other cases who have received the same sort of treatment in which the results are not so brilliant, yet I am convinced that this form of treatment is a great adjunct to surgical measures and should form the after-treatment in all operative cases and the chief feature in non-operative cases.

Being convinced of the greater advantages to be gained by eliminating the disease from the structures in the genital tract above the epididymis, and yet being fearful of a radical surgical procedure which attempts to wholly eradicate the disease; because of the difficulties, dangers, and failures, I have chosen to attempt to remove the disease from the vas, vesicles, and possibly the prostate, by performing epididymectomy or castration, injecting the vas with crude carbolic acid, and later employing hygiene and tuberculin. The

idea of this form of treatment was suggested by Belfield's paper entitled "Irrigation and Drainage of the Seminal Ducts and Vesicles Through the Vas Deferens" in which he advocated treatment of the infected vesicles by injections through the vas deferens, and from the results of the treatment of the tubercular ureter by the injection of carbolic acid following nephrectomy as practiced at the Mayo Clinic.

The number of cases subjected to this method of treatment in which the results are known is 32. In 14, lesions of the epididymis alone could be demonstrated, prior to operation. In 18, lesions of the vesicles were present, and in 15 lesions of the vesicles and prostate also, were evident. In 5 patients the lesions in the epididymis were bilateral. Three patients had tuberculosis of the bladder and unilateral renal tuberculosis. No cases with bilateral renal tuberculosis were subjected to epididymectomy or castration and are not considered in this report. Twenty-three had phthisis and 2 had tuberculosis of the bone. Thirteen were subjected to unilateral epididymectomy; 2 to bilateral epididymectomy; 1 epididymectomy on one side, and castration on the other; 14 were subjected to unilateral castration, because the disease involved the testicle, and 2 bilateral castration; 3 had a subsequent epididymectomy for recurrent disease; and 4 had a subsequent castration for recurrent disease; 1 had a subsequent nephrectomy; and 2 had previously had a nephrectomy for tuberculosis. I have previously mentioned a case of tubercular epididymitis on one side and a gonorrhœal epididymitis on the other. The tubercular epididymis which was removed, showed both a tubercular and gonorrhœal infection. Of these 32 patients, 7 are known to have died. The following table shows deaths by year and causes.

Year	Post-operative	Number of Patients	Per Cent	Remarks
1st	9 months	1	3	"Nervous breakdown." Suicide.
2d	16 months	1	3	Pott's disease and phthisis.
3d	29 months	2	6.2	Phthisis—miliary tuberculosis.
4th		0		
5th	30 months	1	3.1	Phthisis—urine negative.
6th		0		
7th		0		
8th		1	3.1	Phthisis, urine negative.
9th		1	3.1	Tubercular lungs and kidneys.

Of this series of 32 patients the urine has recently been studied in 25, these being alive at the present time, and no evidence of genital tuberculosis is to be found in 21. One has tubercular lesions in the bladder and prostate, five years after unilateral castration and is one of the cases in which a nephrectomy was done. One has bilateral renal tuberculosis 7 years after operation, and two have tubercular lesions in the prostate and possibly the vesicles, one four years, and one three years after operation. Of the remaining 21 cases there is no evidence of the disease in the local examination, the urine is negative, and smears of the massage fluid from the prostate and vesicles is negative in each instance. In but one patient was the inoculation of urine into guinea pigs positive, and this case had a right castration in December, 1914, and a left, February, 1915. The urine is negative by urinalysis and the smears negative. This patient is in excellent health and the inoculation findings were a surprise.

To summarize: Of these 32 cases, 7 or 21.7 per cent have died in 10 years; 25 or 88.3 per cent are living; 4 have demonstrable tuberculosis in the genito-urinary tract; 1 has no demonstrable tuberculosis, but the inoculation test is positive; 20 or 62.5 per cent are locally free from the disease.

The operative technique is briefly as follows: The patient comes to the operation with at least one hour's urine in the bladder, or if the bladder is empty, about 4 ounces of water is injected. After performing epididymectomy or castration, the vas is injected with a drachm of crude carbolic acid by means of a syringe fitted with a metal tip; usually employed to make injections into a ureter catheter. The vas is brought to the surface of the skin through a stab wound above the scrotum and held by a catgut suture, the lumen being unobstructed. The scrotal wound is closed with or without drainage, as the case may indicate, and an alcohol dressing applied to neutralize any of the carbolic acid which may escape. The urethra is washed out to remove any carbolic acid which may have escaped into it; but as a rule the acid runs back into the bladder and is diluted by the bladder fluid.

Upon recovering from the operation the patient usually voids early as the irritation from the carbolic acid is evident, and because the bladder contains fluid at the time of operation. In a few instances the patients have required catheterization.

Pain during the first few days after operation is often considerable, requiring liberal doses of morphia; yet some patients have had little or no pain. In a few, micturition has been so frequent and painful that an indwelling catheter has been necessary, and several patients have passed blood in small amounts, mixed with the urine, for a few days to a fortnight. There is rarely "vesicle colic" and rectal irritation, and the urine may contain much detritus for many weeks. There has been no evidence of carbolic acid poisoning.

The reaction from this method of treatment, while severe in some cases, is slight or absent in others, and whatever immediate discomfort there may be is of only passing interest if we can free the genital tract of so severe a disease.

The examination of the vesicles and prostate months following operation usually shows the vesicles to be small fibrous bodies, if palpable at all, and the prostate sometimes quite normal, but often sclerotic; and the material expressed by massage is small in amount. In no instance has the massage fluid following operation shown the tubercle bacillus in smears, and in no instance has a contracture taken place in the urethral canal.

Following the healing of the wound and the subsidence of any febrile state, the patients have been given tuberculin, the dose being at first small and gradually increased. The general hygienic measures, commonly employed in tuberculosis, are insisted upon and carried out indefinitely.

CONCLUSION

1. The post-mortem and clinical findings show that the great majority of cases of genital tuberculosis have active tuberculosis elsewhere in the body, the infection in the genito-urinary tuberculosis being a secondary infection.

2. It must be considered that the majority of cases of tubercular epididymitis have tuberculosis of the vesicles and prostate on the corresponding side, whether the condition can be demonstrable by physical examination or not.

3. Cases of genital tuberculosis often have associated tuberculosis of the bladder and kidney, and a cystoscopic examination with catheterization of the ureter should be a rotation procedure, in each case, before the possibility of such associated infection can be eliminated.

4. In the opinion of the writer the best treatment for the local condition, in most instances, is to remove the scrotal focus by epididymectomy or castration, and this should be followed by injecting the vas with a drachm of crude carbolic acid, with the hope of eradicating the disease from the genital tract.

5. That the destruction of the local focus by this procedure is but the first step in the process of immunizing the patient against fresh outbreaks of the disease; and that hygiene and tuberculin should be made use of indefinitely, as they serve further to aid, in a rational way, the immunizing power of the body against remaining lesions.

BIBLIOGRAPHY

WALKER, G. Studies in the Experimental Production of Tuberculosis in the Genito-Urinary Organs.

SIMONDS, M. Ueber Tuberkulose der Scheidenhaut des Hodens, Deutsche Ztschr. f. Chir., 1882, xviii, 157; Ueber primare Tuberkulose der Samenblasen, Muenchen med. Wchnschr., 1906, liii, 778; Ueber Tuberkulose des maennlichen Genitalapparates. Deutsch. Arch. f. klin. Med., 1886, xxxviii, 571; Tuberculosis of the male genital organs. Beitr. z. Klin. d. Tuberk., 1914, Nov.; ibid., 1915.

OPPENHEIM, J. Zur Kenntniss der Urogenitaltuberkulose. Ziegler's Beitr. z. path. Anat. u. z. allg. Path., Jena, 1888, iii, 295.

OPPENHEIM, M., and LOW, O. Klinische und experimentelle Studien zur Pathogenese der gonorrhoischen Epididymitis. Virchow's Arch. f. path. Anat., etc., Berl., 1905, clxxxii, 39.

OPPENHEIM, M. Ueber urethrale tuberculin-reaktion. Wien. klin. Wchnschr., 1908, xxi, 1294.

v. KRZYWICKI, C. 29 Falle von Urogenitaltuberkulose darunter ein Fall von Tuberkulose beider Ovarien. Ziegler's Beitr. z. path. Anat. u. z. allg., Jena, 1888, iii, 297.

COLLINET, L. Considérations sur la tuberculose des organes génito-urinaires de l'homme. Thèse de doct., Par., 1883.

SAXTORPH, S. Valeur de l'intervention chirugicale dans la tuberculose vésicle. Comp.-rend., XIII cong. internat. de méd., Par., 1900, p. 97.
TEUTSCHLANDER, O. R. Die Samenblasentuberculose und ihre Beziehungen zur Tuberculose der ubrigen Urogenital-organe. Beitr. z. Klin. d. Tuberk., 1905, iii, 215. Wie breitet sich die Genitaltuberkulose aus? (Ascension and Descension.) Beitr. z. Klin. d. Tuberk., 1906, v, 83.
GUISY, B. Tuberculose prostatovesiculaire. Rev. internat. d. l. tuberc., 1906, v, 81; Rev. prat. d. org. génito-urin., 1907, iv, 170.
SOCIN, A. Die Krankheiten der Prostata. Handb. d. allg. u. spec. Chir., Stuttgart, 1875, iii, 2.
SOCIN, A., and BURCKHARDT, E. Die Verletzungen und Krankheiten der prostata. Deutsche Chir., Stuttgart, 1902, p. 53.
CRANDON, L. R. G. Tuberculosis of the prostate. Boston M. & S. J., 1902, cxlvii, 17.
ORTH, J. Pathologische anatomie, Berlin, 1889, 409; Ref. in Centralbl. f. allg. Path. u. pathol. Anat., 1905, xvi, No. 20; Lehrbuch der speziellen pathologischen Anatomie, 1893, ii, Part. 1; Experimentelle Untersuchungen ueber Futterungstuberkulose, Virchow's Arch. f. path. Anat., etc., Berl., 1879, lxxvi, 217.
DREYER, A. Beitrag zur Pathologie der Samenblaeschen. Inaugural Dissertation, Gottingen, 1891.
BARNEY. J. Am. M. Ass., 1914, p. 2274.
BELFIELD. Irrigation and drainage of the seminal ducts and vesicle through the vas deferens. Tr. Am. Ass. Genito-Urin. Surg., 1906.
CUNNINGHAM. Tr. Am. Ass. Genito-Urin. Surg., 1909, p. 51; ibid., p. 104.
KRAEMER. Ueber die Ausbrietung der Tuber. im Maennlichen Genitalsystem. Beitr. z. Klin. der Tuberk., 1915, June, p. 259.
HAAS. Beitr. z. klin. Chir., Tuebingen, 1901, xxx, 345.
WHITESIDE. Tr. Am. Ass. Genito-Urin. Surg., 1914.

THE TREATMENT OF THE FATTY CAPSULE AND THE URETER IN NEPHRECTOMY FOR RENAL TUBERCULOSIS[1]

BY HERMAN LOUIS KRETSCHMER, M.D., F.A.C.S., CHICAGO
Urologist, Presbyterian Hospital; Genito-Urinary Surgeon, Alexian Brothers' Hospital; Junior Surgeon, Children's Memorial Hospital

IN a consideration of the surgical treatment of renal tuberculosis, two facts stand out prominently: (1) the present status of the question relative to the diagnosis and treatment of renal tuberculosis; (2) the fact that the management of the fatty capsule and the ureter has not been as definitely settled as has the former.

With reference to the first topic, I should like to refer to Cabot's introduction to a recent article on this subject, in which I think he sums up the question of diagnosis and treatment as well as it can be. "Though many points connected with the diagnosis and treatment of renal tuberculosis have been practically settled during the past ten years, much still remains to be done. In expert hands the questions of diagnosis have been well cleared up, and the formerly much discussed question of the advisability of surgical treatment has ceased to play an important part. The tendency to watchful waiting which was generally but another name for medical procrastination, has considerably abated, and there is practically no difference of opinion, among those qualified to express one, that in unilateral renal tuberculosis, operation offers the only chance of cure, and the so-called medical treatment only prolongs the agony."

When, however, our attention is directed to a consideration of the management of the fatty capsule and the ureter in nephrectomy for renal tuberculosis, one finds a great many different expressions of opinions, somewhat analogous to the unsettled and chaotic condition which the entire question of surgery of kidney tuberculosis was in ten years ago. Because of these facts, one is justified in stating that the question of treatment of these two structures is not as definitely settled as are the questions of diagnosis and treatment.

Until comparatively recently the fatty capsule has been either ignored or sadly neglected. Many of our standard textbooks do not refer to it at all. Just why it should have been overlooked is not clear. Many of the more recent writers attribute to it the possibility of its being one of the causes of post-operative sinus formation after nephrectomy, and that not all of the post-operative fistulæ or sinuses are due to the ureteral stump. A consideration of the fatty capsule as a factor in the production of fistulæ

[1] Read as part of the symposium on "Tuberculosis of the Kidney," American Urological Association, St. Louis, April 17–19, 1916.

or of an infection of the wound by tuberculosis cannot be undertaken without reference to the lymphatics.

The most extensive work on the lymphatics of the kidney and its capsule has been done by Stahr. He has shown that there are two capillary networks within the fatty capsule of the kidney. A coarser network which lies under the peritoneum, superficially in the fatty capsule. A second capillary network lies in the deeper layers of the fatty capsule, close to the kidney substance. This is a delicate network and, according to Stahr, is in direct communication with the lymph-capillaries of the kidney cortex. By injection preparations he was able to demonstrate that the kidney possesses a rich network of lymphatics. *The different lymphatics leave the kidney at the hilus, but in spite of this he has demonstrated that a lymphatic connection exists between the lymphatics of the kidney and its capsules.*

These anatomic facts are of much importance in a consideration of the treatment of the fatty capsule. If we accept Stahr's work as having proved that this lymphatic connection exists, then it is reasonable to expect that in all, or in the largest majority of cases, the fatty capsule must sooner or later become infected. The possibility of the fatty capsule becoming infected in each case naturally brings up the question of whether or not it is proper to remove it as a routine in every case.

Clinical evidence of involvement of the fatty capsule is seen in some of the late cases in which, at the time of operation, the fatty capsule can be recognized as being definitely pathological. Schlaginweit, in one of his cases, found a pathologically altered and enlarged lymph-node about the size of an almond, in the fatty capsule.

Legueu maintains that the fatty capsule is almost always changed, indurated, and more or less adherent to the kidney. Sometimes the lesions are purely inflammatory, but they are generally tuberculous, and many authors have demonstrated specific lesions in them (Israel, Albarran, Pousson, Kapsammer, Kidd).

Tuberculosis of the fatty capsule may be evident in cases where tuberculous granulations are seen on the surface of the kidney. Not only are tuberculous changes found in cases in which the fatty capsule appears altered to the naked eye, but they have also been found in cases in which the fatty capsule appeared perfectly normal. Legueu has demonstrated microscopic tubercles in the perirenal fat, in pieces of the fatty capsule taken at random from areas that appeared normal to the naked eye.

These facts would appear to be rather conclusive evidence in favor of a removal of the perirenal fat, or as much of it as possible, in cases of nephrectomy for tuberculosis. Albarran believed that the course of the disease was shortened by secondary removal of the fatty capsule. However, Schlaginweit, holds opposite views; in his first nine or ten nephrectomies he removed the fatty capsule with a great deal of trouble and loss of time, but since then he has left it in place. He believes that if the fatty capsule is normal, soft, and does not contain any palpable glands, it does not do any harm: if it is hard and rigid, it has formed a protective wall before the operation and will continue to do so afterward. Recommendations to remove the fatty capsule have been made by Kuester, Koenig and Pels Leudsen, Kidd, Wildbolz, Kelly, Watson and Cunningham, and others.

During the past three years I have made it a routine procedure to remove as much of the fatty capsule as possible. This was carried out after the kidney was removed. In cases in which there has been a good deal of perinephritis, with extensive thickening of the fatty capsule, so that extensive adhesions are present, rendering the removal dangerous, it may be necessary to forego its removal. The danger of injury to the peritoneum with resulting tuberculous peritonitis is obvious.

THE TREATMENT OF THE URETERAL STUMP

The management of the ureter has caused more discussion than perhaps any other phase of the subject, and it is the one which up to the present time has not been satisfactorily settled to all concerned. The many different ways of treating the ureter which have been advised is proof that the ideal method has not been obtained.

When nephrectomy was first recommended, it was also advised to remove more or less completely the diseased ureter. The more recent train of thought seems to be to remove only a part of the ureter; as much as can be conveniently removed through the lumbar incision, which usually means to the brim of the pelvis.

Total extirpation of the ureter to the bladder, or to include a piece of the bladder, was not a very long-lived procedure. These procedures were recommended by Alessandri, Garceau, Giorgano, Ramsey, Goetzl, Kelly, Reynolds, Israel, Kapsammer, and others. This method soon fell into disfavor because it did not fulfill its claims, because of the increased mortality rate, and because it did not prevent post-operative fistulæ. Although the present-day tendency is not to do extensive resections, Longard has described a new technique which has for its object the removal of as much of the ureter as possible.

The kidney is exposed by the usual lumbar incision; after the vessels have been ligated and the kidney freed, the ureter is freed down to the pelvis, and a second incision is made parallel and close to Poupart's ligament. The incision is carried through the muscles to the peritoneum, the kidney and the attached ureter are pulled through this incision, after which the ureter is divided and fixed into the wound. In large kidneys, or where there is danger of rupturing large pus-sacs, he divides the ureter in the kidney wound, covers the end with gauze, and then pulls it through the lower incision with a forceps. His method slightly modified has been advocated by Lillienthal.

Suture of the ureter to the skin. This method was advised in order that the ureteral mucosa could be treated directly and to prevent infection of the wound with tuberculosis and fistula formation. Israel, in his analysis of 1023 cases, obtained figures showing that fistulæ occurred in 10 per cent of cases in which the ureter was allowed to drop back into the wound, whereas sewing the ureter into the wound was followed by fistulæ in 16.3 per cent of cases.

Treatment of the ureteral mucosa has been varied. Kuemmell uses a special thermocautery which is introduced into the ureter, and Albarran, Tuffier and others, sear it with heat. Electrolysis has been advised. Israel prefers the injections of pure fluid carbolic acid into the lumen of the ureter, filling up the entire ureter, and Koenig injects tincture of iodine. In order to bring about an early healing, Paschkis advises that the stump be given antituberculous treatment after the operation. Zuckerkandl recommends 6 per cent carbolic acid. The mucosa near the end of the ureter has been removed with a curette. Comment on these varied recommendations is unnecessary.

METHODS OF SEVERING THE URETER

These have been varied. The end of the ureter may be crushed with a heavy forceps and cauterized with carbolic or iodine. Others prefer to burn through the ureter very slowly with the actual cautery.

Invagination of the cut end of the ureter by a purse-string somewhat similar to the technique in appendectomy has been suggested in order to insure a more thorough closure of the cut end either with preliminary crushing of the ureter or with ligating. Ligation and invagination have been criticised because the end containing the ligature lies in the lumen of the ureter. This method has been advocated by Koenig, Kuester, Pels-Leusden, Krecke, Jansen, and others.

That occasionally special treatment is not necessary is demonstrated by Schlaginweit. In several cases the ureter was simply cut off and allowed to retract. The cases ran a usual post-operative course. Taddei has shown by experiments that the ureter closed quicker when it was not ligated. When it was ligated, hollow spaces formed in the walls resembling true cysts. There was never a trace of reflux of urine into the wound. The ureter atrophied quicker when no ligature was applied; therefore in non-septic conditions he advises against ligation of the ureter. One would not feel justified, however, to apply the results of Taddei's animal experiments in his own clinical cases.

At the present time, based upon past experience and results, by far the largest number of surgeons are practicing less radical

measures than formerly, so that only a partial ureterectomy is carried out.

I have never attempted extensive resections of the ureter, being content to remove as much of the ureter as I could through the lumbar wound. Usually I was able to divide the ureter at the pelvic brim, and occasionally just below it. The ureter was divided between heavy artery forceps. The cut end was treated with carbolic acid and tied with heavy catgut, and allowed to drop back into the wound. The objection to leaving a stump of the ureter has been that it continues to pour infectious material into the bladder, thereby infecting a clean bladder or delaying the healing of an already infected bladder. Who can say that a long stump is any more infectious than a short one?

Albarran, Kuester, Koenig, and Pels-Luesden, Suter, Mayo, Legueu, Cabot, Squier, Borelius, Kidd, and others are all doing partial ureterectomies. Post-mortem examinations of the stump after nephrectomy have shown that the ureter has undergone atrophy and been converted into a hard, fibrous cord.

Attempts have been made to modify the technique according to the pathological condition of the ureter. Some believing that the technique should be based upon the condition of the ureter as found at the time of operation. As a rule, however, the condition of the ureter has not been taken into serious consideration.

Albarran's decision whether a conservative or radical ureterectomy should be carried out, is reached upon the ureteral findings. If the thickened ureter is increased in circumference because of a thickening of its walls, and if its lumen is small, he proceeds as usual in that he resects as much as can easily be resected, and these cases heal without fistulæ formation. If the ureter is very thick, and the lumen on cross section is dilated, then and only then should ureterectomy be carried out as completely as possible. In these cases the vesical end of the ureter is dilated and altered. This is the type, he believes, in which the bladder urine flows up the ureter and into the lumbar wound.

THE INFLUENCE OF EARLY DIAGNOSIS

Tuberculosis of the kidney is no exception to the rule that an early diagnosis is by far better than a late one. From personal observation I believe that cases in which an early diagnosis is made and in whom an early operation is performed, have less bladder disturbance after the operation, and that bladder symptoms persist for a much shorter time than they do in those patients who come to us late in the course of the disease.

At rare intervals one may see a case in which there is *no evidence* of bladder or ureteral tuberculosis cystoscopically. This group of cases undoubtedly have a much better end-result than do those in whom at the time of operation, an extensive tuberculosis of the bladder exists.

By many these facts are held responsible for fewer ureteral fistulæ and hence a shorter period of wound healing. One must not forget, however, that in renal tuberculosis involvement of the ureter occurs quite early.

While many authors believe that fewer post-operative fistulæ and a shorter wound healing are directly due to an early diagnosis and early operation, these views are not held by all. Some believe that post-operative fistulæ are not due to any particular type of ureteral tuberculosis but to a better operative technique, rigid asepsis, and a more careful division of the ureter.

PRIMARY CLOSURE

The formation or occurrence of post-operative fistulæ and infection of the wound by tuberculosis has resulted in the various methods of treatment of the ureteral stump and the fatty capsule. The objects of these methods, however, were not attained. This failure was quite common, so that some (Oppel, Stein) did not try to obtain primary wound healing. Instead they packed the wound with gauze and allowed it to heal by granulation.

This technique must of necessity prolong the convalescence, and, as a routine procedure can hardly be recommended, except in an occasional case in which the wound may have been contaminated by pus due to rupture of one of the thin walled sacs.

Quite the opposite treatment has been advocated by Mayo who advises against drainage. In cases in which the wound is soiled by infected material this is wiped out, the cavity filled with normal salt solution and the wound closed without drainage. If this method succeeds it will add greatly toward shortening the convalescence.

Cabot and Crabtree's interesting study of their cases closed without drainage shows that only 25 per cent remained tight. Another fact of much significance brought out in their paper is that in their cases in which an abscess developed it occurred in three to five weeks after the patients left the hospital. This fact is especially significant when reporting cases of primary closure; unless the cases are watched after leaving the hospital, one might easily come to wrong conclusions.

REGURGITATION OF URINE

Regurgitation of urine into the remaining ureteral stump and its discharge through the lumbar wound may be the cause of a persistent sinus. Tuberculosis of the ureter often results in a destruction of the ureterovesical valve, so that there is nothing to prevent the flow of urine through the lumbar wound. This complication, however, is rare. I have seen it but once. One might be guided in his attempts to prevent this complication by the cystoscopic findings.

THE CLINICAL AND PATHOLOGICAL EVIDENCES OF THE POSSIBILITIES OF SPONTANEOUS HEALING OF RENAL TUBERCULOSIS WITHOUT TOTAL DESTRUCTION OF THE KIDNEY[1]

By EDWARD L. YOUNG, Jr., M.D., Boston
Genito-Urinary Surgeon, Out Patient Department, Massachusetts General Hospital

IN any discussion involving a number of terms which may be used with varying shades of meaning, it is only fair that a complete understanding of what we mean by our use of words should be made plain that no doubt or question should arise later.

As evidence of renal tuberculosis we must have tubercle bacilli and evidence of renal inflammation coming from the kidney. It is not enough that these elements come from a bladder urine since genital tuberculosis in either sex, coming from the epididymis or the prostate in the male or from the fallopian tubes in the female, give such a urinary content; it is not enough that the bacilli be found in the urine when obtained direct from the kidney if there is no other evidence of kidney involvement since it has been proved beyond doubt that normal kidneys excrete living tubercle bacilli coming to them in the blood from other tuberculous foci in the body. And in as much as no one will deny the possibility of small active tuberculous foci in the body which are undiscoverable on physical examination, bacilli alone in the urine cannot be accepted as evidence of renal involvement.

By healing we mean a complete destruction of a tuberculous focus so that no living tubercle bacilli remain. It is not enough that a caseous area is completely surrounded by a wall of fibrous tissue however dense, so long as the center is not completely organized. Kurlow and Green by use of the microscope and guinea-pig inoculation proved conclusively that as long as caseation existed there remained the possibility of further infection. It is true that under the best of artificial conditions a strain of tubercle bacilli will die in a comparatively few weeks, but these are not and cannot be the conditions existing in the body, and at present we have no means of knowing how long tubercle bacilli in a caseous mass can retain their vitality and power of doing harm. By healing then we mean the destruction of all of the tubercle bacilli and the reduction of the caseous nodule to a harmless condition.

[1] Read before the American Urological Association, St. Louis, April 17–19, 1916.

By spontaneous healing we mean not only without any treatment at all but by the use of any treatment outside of the knife.

What can we accept as a sufficient proof of a healed renal tuberculosis? Nothing less than the operative or autopsy evidence of what we know is a characteristic organized tubercle or collection of tubercles taken from the kidney of an individual who showed during life tubercle bacilli and evidence of renal inflammation coming from that kidney.

Clinically there have been many reports of cases of renal tuberculosis where the diagnosis was certain and where either without any treatment or because of, or coincident with, the use of some special therapeutic agent the clinical signs and symptoms entirely disappeared: pus and albumin and tubercle bacilli could no longer be found in the urine and the vesical symptoms of irritability ceased, and the patient gained in weight and general condition.

Pardoe reported 21 cases in which 5 "appeared to be cured" by the use of tuberculin in very early cases where there was little if any bladder involvement. But recognizing the possibility of long remissions in the signs and symptoms he did not consider proof of the cure at all complete.

Thompson Walker also considered the use of tuberculin as likely to give freedom from symptoms for a long time but did not believe that a cure ever resulted.

Keyes reported three cases before this association in which there was a remission of from 2 to 17 years. In the case with remission for the longest time, the diseased kidney was entirely destroyed as proved at autopsy. In the other two there was a flare up of the disease and nephrectomy was done.

Heitz-Boyer reports one case in which there was no suspicion of tuberculosis in the history, physical examination, or cystoscopy. Reexamination two months later showed a closed left kidney which had not been diagnosed on the first examination. A few months later the patient died of uræmia.

He cites another case in which a patient was supposed to have been cured of renal tuberculosis, but twelve years later had a swelling in her loin which did not interfere with her general health and activities so that she did not consult with a physician for eight years more. A nephrectomy done at that time showed a totally destroyed caseous kidney.

Mantoux advocated the use of tuberculin in renal tuberculosis and claimed that the general health was much improved and also that the local condition was changed for the better and although among seventy cases which he observed some were at one time or other almost free from symptoms, he nevertheless did not claim a cure by means of medical treatment and insisted that operation gave the only chance.

Le Clerc Dandoy adopted Keersmaeecker's method of administering tuberculin treatment which consists in giving intravenous injections of cinnamylic acid every week, increasing the dose up to 20 mg. At the end of six months this is stopped and the tuberculin is given in slowly ascending doses. He reports five cases in which a diagnosis of renal tuberculosis was made and in which after several months' treatment by the mixed method the symptoms entirely cleared up and the urine became entirely normal. Two of the five cases give all of the symptoms necessary to make a diagnosis, but the final proof of cure is lacking.

Pousson has reported one case with remission of symptoms for eighteen years and then further trouble and he has become reluctantly convinced that renal tuberculosis cannot be cured except by removing the kidney.

None of the reported cases on close examination fulfil all of the requirements necessary to establish definitely the proof of a cure and many of them do not have all of the data possible to obtain during life. The cases reported by Keyes showed at one time all of the clinical phenomena consistent with a cure and had the final flare-ups not been reported would have been used as evidence of a cure instead of standing as they do as strong arguments against. In the literature on renal tuberculosis I have not been able to find any case reported which shows positive proof of the disappearance of a renal tuberculosis.

The following reports of cases studied on the Genito-Urinary Service at the Massachusetts General Hospital are of considerable interest in this connection:

G. U. Service No. 203058. Female, age 31.

Symptoms of intermittent pain in left side for three months, no other symptoms, and well up to that time. The urine showed a moderate number of leucocytes, no albumin, no growth on culture, but a diphtheroid bacillus in smear. Cystoscopy showed that the leucocytes came from the left kidney. Operation by Dr. Cabot showed that the upper pole contained a cyst shut off from the pelvis of the kidney. The upper pole was resected under the impression that it was a solitary cyst, no suspicion of its nature being entertained. Normal convalescence. The diagnosis was only revealed by the pathologist.

G. U. Service No. 204737. Female, age 48.

Four months symptoms of chills, fever and weakness slowly increasing with an ache in the left flank. The examination was typical of a coccus infection of the left kidney with perinephritic abscess. Operation showed this condition and because the kidney was badly damaged it was removed. Pathological examination showed the coccus infection but in the upper pole was a small caseous cavity partly organized which was tuberculous.

G. U. Service No. 180935. Female, age 54.

Five years ago urgency and frequency and three years ago tumor in left flank. Nephrotomy was done at this time. Sinus persisted and two years ago an attempt was made to cure this by operation without success. Nephrectomy was done.

Pathological report: "Section showed no kidney substance. A number of small abscesses filled with thick pus but a large amount of the tissue consists of soft yellowish material. Microscopical examination shows the kidney tissue replaced by a round and epithelioid cell growth throughout which were masses of large scattered giant cells."

In these cases there was a shut off tuberculous process which it was impossible to diagnose as such without microscopic study, but in one no evidence at all of any attempt at healing, in one only a slight attempt, while in the third a considerable degree had gone on, yet in no sense of the word to completion.

Pathological evidence at our command is unfavorable to the possibility of the healing of tuberculosis of the kidney. Wherever tubercle bacilli lodge and start to develop they arouse a reaction which is essentially the same under all conditions, the particular tissue invaded causing only minor differences. The process of growth and attempt of the tissue at walling off and healing the damage is likewise essentially the same. Histologically the process is in brief as follows: The presence of the bacilli is the signal for an accumulation of endothelial cells around them in an attempt to neutralize in some way the damage being done. These endothelial cells together with lymphocytes and new connective-tissue cells gradually get more numerous and the shutting off of the blood supply begins in the center of the tubercle. If healing is to take place the newly formed connective-tissue cells grow into this necrotic center and gradually absorb and take the place of it. There may be a hyaline degeneration of this ingrowth but the round-cell infiltration and the more or less characteristic center always remain to mark the spot. In the larger tubercles the caseous center may be replaced by a calcification surrounded by a dense fibrous wall. This picture is characteristic and can be distinguished from the scars in the kidneys of various origin which masquerade in the literature as healed tubercles. Both types are found in the foci of healed or obsolete tuberculosis elsewhere in the body. That this is the natural process which should take place in the kidneys, we know from a few reported cases where such an attempt has been made but without success.

Harbitz reports a number of autopsy and post-operative cases where the tuberculous process had disappeared after complete destruction (autonephrectomy) of the kidney but one case of particular interest.

A woman, age 33, with symptoms of right-sided kidney trouble for two years. Tuberculosis could not be found. Nephrotomy showed nothing wrong but the wound left a persistent sinus. Three months later nephrectomy. Macroscopically no evidence of tuberculosis, but microscopically there are typical tubercles some of which have gone on to almost complete organization but some of which still are active.

Wildbolz, recognizing that a marked improvement in general condition followed the use of tuberculin in many cases, thought that a corresponding healing might take place in the infected kidney. In four cases he used tuberculin for 2 to 12 months before operation with improvement in general health and with some benefit as regards symptoms. He did a nephrectomy in all of these cases and examined the kidneys care-

fully to see what, if any, healing had taken place. Nowhere was he able to find any evidence of any process which suggested an attempt at healing. He concluded that although medical treatment might improve the general condition of a patient with renal tuberculosis it did not in the least help the local lesion and that removal of the kidney was the only permanent cure.

Zuckerkandl in discussing the possibility of the shut off tuberculous pyonephrosis also describes the indurated tuberculous kidney where the tissue reaction has resulted in a partial healing of many of the foci with a marked fibrous tissue reaction around the tubercles and a sclerotic condition of the whole kidney with a thinning of the cortex and a hardening of the parenchyma. In one case which he describes there was also a fatty infiltration of the tissue near the pelvis. But in all of the cases there were demonstrated one or more small active foci. It is to be noted that this process is destructive of the kidney and not healing. Zukerkandl concludes that "induration of a tuberculous kidney and hardening of the parenchyma may be taken as a local recovery but never absolute." (One might suggest that this type of healing is not of advantage to the kidney.) "The diseased kidney even after complete induration is always a present menace to the other kidney and its removal is urgently recommended."

Reasoning from still another point of view suggests that healing should be a difficult if not an impossible task. Immunity is aroused very slowly in the body by a focus of tuberculosis anywhere. In the lungs, where the anatomy is such that the growth may be very slow in extension and yet the blood supply so abundant that the toxines are rapidly absorbed and disseminated and the greatest opportunity given for antibodies to be formed, such an immunity is often aroused and the process limited, walled off, and finally healed before it has become too large to handle. In the kidneys the conditions are slightly different in that extension takes place more rapidly and the antibodies are formed less quickly. By the time these antibodies have been formed to any great extent the focus is so large that the most that can be accomplished is the walling off of the process without complete healing. Whether this is the exact explanation or not really matters little but I am convinced that the question of immunity is the real answer to the problem. In reviewing the course of the patients on whom nephrectomy for tuberculosis had been done at the Massachusetts General Hospital, Crabtree and Cabot found that the cases which had done the worst were the early cases, those in other words who had not had time to arouse an immunity. Other reports from other clinics revealed the same thing.

I had one experience of this kind which illustrates this condition:

A boy of 18 came for slight frequency. His urine was clear but contained a slight trace of albumin. Cystoscopy showed slight reddening around one ureter and on the strength of that he was sent into the house for further study. When he came in a short time afterward I was unable to confirm the diagnosis. The bladder was entirely normal. The function of both kidneys was equal. The urine from both kidneys was clear and sparkling. There were no pus-cells from either side. There was the slightest possible trace of albumin from the supposedly affected kidney. Guinea-pig inoculation on this occasion showed no tuberculosis. I watched him very carefully during the following year. At one time a pig was reported positive from the sound side. He finally developed clear cut signs of renal tuberculosis and I did a nephrectomy. He went steadily down hill from the first with what was apparently a generalized tuberculosis. The kidney showed a tuberculous abscess in one pole without the slightest attempt at healing.

Corbus, in a paper before this association in which he dealt with the question of immunizing patients before operation, makes out a good case on the grounds of preventing a rapid dissemination of tuberculosis from the stirring up of the operation. Many other authorities have advocated a preliminary tuberculin treatment. If we reverse this evidence we find in it a very strong suggestion that there is no process going on in the body in this disease which has any marked tendency to cause healing or else the immunizing process would not be necessary. This seems to me to be the keystone to the whole question. If a person has a strong natural immunity to start with, an initial infection will not gain a foothold. If a process does start in the kid-

ney, the slow course of the formation of antibodies in comparison with the spread of the lesion allows the disease to get beyond the point where it can be entirely obliterated although it can often be walled off so efficiently that the symptoms cease and the condition becomes latent but capable of further mischief if for any reason it gets loose.

It would seem to me from a study of the cases reported in the literature from pathological study, and from reasoning in connection with immunization, that the healing of a tuberculous focus in the kidney is impossible.

BIBLIOGRAPHY

ROEHRIG. Zentralbl. f. d. Krankh. d. Harn u. Sex. Org., Leipzig, 1901, xii, 237.
KRUEGER. Zentralbl. f. d. Krankh. d. Harn u. Sex. Org., Leipzig, 1903, xiv, 229.
WILDBOLZ. Wien. med. Wchnschr., 1911, No. 3, 2314.
ZUCKERANDL. Urologie, 1902, ii, 97.
LICHTENSTERN. Ztschr. f. Urol., 1902, ii, 219.
BACHRACH and NECKER. Wien. klin. Wchnschr., 1911, No. 39, 1363.
BERNARD and HEITZ-BOYER. L'Assoc. franc. d'urol., Paris, 1912, xvi, 1.
MANTOUX. Presse méd., 1910.
DANDOY. Rev. clin. d'urol., 1912, Jan. 26.
GUYON and ALBARRAN. Ann. d. mal. d org. genito-urin., 1891, Feb.
DANDOY, LE CLERC. Bull. soc. roy. d. sc. méd. et nat., Bruxelles, 1910, July 7.
DE KEERSMAECKER. Rapport. Soc. belge d'urol., 1910, June.
RAFIN. J. d'urol., 1912, ii, 517.
HERMANS and DE KEERSMAECKER. Soc. belge d'urol., 1906, Feb. 4.
ROCHET. Cong. d'urol., 1910, p. 448.
HEITZ-BOYER. J. d'urol., 1912, ii, 537.
WALKER. Practitioner, Lond., 1908, No. 80, 723.
PARDOE. Lancet, Lond., 1905, Dec.
FENWICK. Brit. M. J., 1904, Apr., 784.
KEYES. Tr. Am. Urol. Ass., 1913.
CORBUS. Tr. Am. Urol. Ass., 1914.
EKEHORN. Nord med. Ark., Stockholm, 1909.
HARBITZ. Norsk. Mag. f. Lægevidensk, Christiania, 1913, No. 11.
CRABTREE and CABOT. Surg., Gynec. & Obst., 1915, xxi, 669.

OBSERVATION ON ONE HUNDRED AND THIRTY-THREE CASES OF GALL-BLADDER SURGERY WITH ESPECIAL REFERENCE TO THE POST-OPERATIVE TREATMENT

BY R. L. RHODES, A.B., M.D., AUGUSTA, GEORGIA
From the Jefferson Hospital, Roanoke, Virginia.

THE cases reported in this paper were patients in the Jefferson Hospital prior to July 1, 1915, and were operated upon by Drs. Hugh H. Trout and R. L. Rhodes. As this article is chiefly a post-operative study, lues, malignancies, deaths, and of course non-operative cases are excluded. Though the number is small, the value of hexamethylenetetramine seems so pronounced that it was thought appropriate to publish the results in order to stimulate a further study in other and larger clinics.

Of the 133 cases, 32 were male and 101 female. Of the 32 males, 18 suffered from cholecystitis, 6 acute and 12 chronic, and 14 had stones. Of the 101 women, 22 suffered from cholecystitis, 1 acute and 21 chronic while 79 had stones. Thus in men, 43.75 per cent showed gall-stones, whereas in women practically 79 per cent. Concerning the location of the stones 51 or 54.8 per cent were in the gall-bladder alone, 22 or 23.6 per cent in the gall-bladder and cystic duct, 7 or 7.5 per cent in the gall-bladder and common duct, 7 or 7.5 per cent in the cystic duct alone, 3 or 3.2 per cent in the common duct alone; 2 or 2 per cent in the cystic and common ducts, and 1 or 1 per cent stones were found in the gall-bladder, cystic and common ducts. It is odd that in none of these were stones found in the hepatic duct, yet since July 1, three such cases have been encountered.

In women we had 56 cases under 40 years of age and 45 cases more than 40; in men, 9 under and 23 more than 40 years of age. The table of ages according to decades follows:

Decade	Male	Female	Total
First	1	0	1
Second	1	2	3
Third	2	20	22
Fourth	5	34	39
Total	9	56	
Fifth	8	19	27
Sixth	10	21	31
Seventh	3	4	7
Eighth	2	1	3
Total	23	45	

Where a definite history was obtained, the men gave a history of typhoid fever in 59 per cent of the cases, the women in only 24 per cent; pneumonia, men in 47 per cent and women in only 18.5 per cent; however, the women made up for this by giving a history of pregnancies in 86.33⅓ per cent. Jaundice was present or had been noted in previous attacks in only 48.5 per cent. The urine was pathologic in 34 per cent which includes all cases showing even a trace of albumin or a few hyaline casts; in other words anything from absolutely normal. There were heart lesions in only 15 per cent, including all findings other than absolutely normal, the severest lesion being the Adams-Stokes syndrome in a man 76 years old.

One case is worthy of detailed report because of the unusual clinical history.

Male, age 41, brought his son to the hospital with an acute appendix. The father obtained board in a home in which there was a case of typhoid fever. During his stay in town the father consulted us, giving a history suggesting a chronic cholecystitis over a period of about four years. On physical examination this was confirmed and such a diagnosis given. He took his son home on the tenth day. Five days later he returned to the hospital with a very acute cholecystitis, and at operation the gall-bladder was found distended almost to the point of rupture. Cultures from the contents of the gall-bladder yielded a pure culture of bacillus typhosus. He rapidly improved, the temperature was normal on the fourth day, but began to rise again on the sixth day, and continued through a very typical typhoid fever, blood culture and Widal both being positive. In the fourth week of his typhoid he developed a large perirectal abscess which when opened yielded bacillus typhosus in pure culture; following this, the convalescence was uninterrupted.

The point of interest here is the very strong assumption that, having a chronic low grade cholecystitis, he fell a victim to poor prophylactic precautions in the boarding house and developed the disease, and as the resistance of the gall-bladder was already lowered, the acute infection manifested itself there before it became systemic.

There were 4 cases in which the gall-bladder gave symptoms during the course of typhoid fever, all of which came to operation with an acute cholecystitis in less than three months' time. The *operation* consisted in the removal of stones where present and the drainage of the gall-bladder by means of a large rubber tube introduced into the gall-bladder and anchored with chromic catgut. The opening in the gall-bladder was closed with a purse-string suture of chromic catgut, care being taken to invert the edges. Two or three cigarette drains were placed below and around the gall-bladder.

Post-operative treatment. The patients are placed in bed in the prone position and ordered to have nothing by mouth. Proctoclysis by the Lawson method is given—water, dextrose or sodium bicarbonate, either or in combination as indicated—and morphia gr. ⅛, hypodermically every 3 hours, if necessary. Water is usually not allowed by mouth within 24 hours if there has been any appreciable nausea and is withheld longer if much nausea or vomiting exists. Gastric lavage if indicated.

In this series of cases the above outline constituted the basis of the routine treatment in 77 cases in which the average duration of drainage was $35^{6}/_{7}$ days. In 56 cases in which the average duration of drainage was $29^{2}/_{5}$ days — a difference of over six and one-half days — the same treatment was used and in addition hexamethylenetetramine in doses of 50 to 80 grains daily. In cases in which much pus was present at operation, the character of the discharge cleared up more promptly in those getting hexamethylenetetramine. For example:

A male, age sixty-two, chronic cholecystitis with subacute flare-up. In spite of free drainage he continued to run a temperature daily of 100 to 101° until the tenth day when he was given large doses of hexamethylenetetramine. In two days it was normal and remained so throughout the rest of his stay in the hospital.

In none of these cases has there been any trouble referable to the gall-bladder, but among those who were not given hexamethylenetetramine several have had some trouble.

One, male, age sixty, had a cystic and common duct stone with a chronic cholecystitis which drained for 44 days. He returned to the hospital two months later, with the history that his gall-bladder had drained intermittently for five weeks. When not draining he would have attacks of pain, nausea, and vomiting such as before operation. During the last three weeks there had been no drainage and he had had five attacks. He was given hexamethylenetetramine in fifteen-grain doses four times daily, since which his symptoms have disappeared.

Another case, a female, age 24, had stones in the gall-bladder and cystic duct which were drained for 48 days when she left the hospital apparently all right. Four and a half months later she returned to the hospital, having had attacks of pain, nausea and vomiting as before operation. She was given 10 grains of hexamethylenetetramine, every four hours with prompt relief and has had no further trouble. Another case, a female, age 21, had stones in the gall-bladder and an acute cholecystitis. On sixth day after operation her temperature ran up to 102°. The wound drained thick mucopurulent material. Hexamethylenetetramine was begun and two days later the temperature began falling, character of discharge improved until on the eleventh day the temperature was normal and bile drainage with very little pus in it. Further convalescence was uneventful.

In making this comparative study no attempt was made to select the cases but for the most part they were taken alternately with and without hexamethylenetetramine. The larger number without is due to the fact that those having been in the hospital before the study was begun are included because the difference in drainage time is so marked it was thought best to get as large a number as possible for an average drainage time.

Even though the series is small it would seem beyond the realm of coincidence that those getting hexamethylenetetramine should have an average drainage of 6.5 days less; and when it is noted that the character of drainage improves faster and that the end-results are more satisfactory inasmuch as not one who were given it have had any symptoms referable to the gall-bladder after leaving the hospital — as contrasted with at least four among those who did not — it would certainly seem that the use of hexamethylenetetramine would be a valuable adjunct to our post-operative treatment in lesions of the gall-bladder and ducts.

It is possible too that the indications for cholecystectomy may be lessened, especially is this suggestive in that there were several of the "mulberry" type gall-bladders in the series who were given hexamethylenetetramine, and who have obtained perfect relief

NOTE.— During the first few days following operation hexamethylenetetramine is given by proctoclysis because at first the patients are not allowed fluid by mouth, and later to avoid any possibility of upsetting the stomach. After the first week it is given by mouth. The idea has been to give the drug five days each week and omit for two days to prevent any untoward symptoms. However, should these develop earlier it is stopped for a day or two and then begun again.

PRELIMINARY HÆMOSTASIS IN GOITER OPERATIONS[1]

By Dr. F. de QUERVAIN, Basel, Switzerland
Professor of Clinical Surgery

GOITER operations are based on one of two principles: either the surgeon follows no special plan, excising the goiter as he would any other tumor and ligating the blood-vessels as they bleed, or he follows methodically a definite plan based on the anatomy of the thyroid gland. The first mentioned procedure predominated in the early days of goiter surgery; for the past 30 years, however, the methodical plan has been recognized as the only correct one.

Though most surgeons of the present day follow the second plan, their methods in operating still differ materially. Some show atavistic leanings toward the older method. It is true, they expose the goiter according to rule, free it from its surrounding tissues, and luxate it, clamping and ligating the vessels when blood flows. Others proceed more logically. The goiter once delivered, the arteries are ligated successively, as it is the area supplied by the arteries from which the principal hæmorrhage may be expected. With this step it seemed the summit of logical operating had been attained. Yet it was not so.

Let us follow an operation on an exceedingly vascular goiter with strongly developed capsular veins. We find that the shelling out of the diseased gland from its enveloping thyroid fascia, the so-called external capsule, and its dislocation can sometimes be an excessively sanguinary proceeding. If, then, we apply ligatures to the most important arteries after luxating the goiter, we apply them too late for one of the most sanguinary stages of the operation. Therefore we see that to be really logical we should ligate the principal blood-vessels before shelling out and luxating the goiter. This line of reasoning led me, five years ago, to modify my operative technique which coincided with that of Kocher and to develop a method which would emphasize the principle of preliminary ligation more forcibly than had hitherto been the case. The chief point in question was the ligation of the most important arteries before doing anything whatever to the goiter. In addition to the above-mentioned motive of exposing and luxating the goiter with decreased hæmorrhage, a further consideration presented itself; viz., that the delivery of a profound, intrathoracic, richly vascularized goiter is much easier after the circulation has been interrupted than when blood is coursing through the blood-vessels. Further, my method protected the recurrent laryngeal nerves more efficiently than the technique heretofore used, and the same time preserved the parathyroid glandules.

I described my method first in December, 1911, and then more fully in the spring of 1912.

After these few introductory remarks, I shall describe briefly how the different arteries can be ligated. We will begin with the *arteria thyreoidea inferior*. As I explained in my previous paper, this artery is, as a rule, the chief source of blood supply to the goiter. Formerly, but quite wrongly, its ligation was supposed to be difficult. A glance at the accompanying schematic sketch (Fig. 1) will show us that this artery can be ligated at four different points.

a. Billroth tied the artery quite close to the goiter. Until recently Halsted ligated it at its entrance to, or, to be more exact, within, the goiter ("ultraligation"). In our publication of 1912 we pointed out the disadvantages of his procedure and see with pleasure that Halsted himself has recognized our reasons, and that from his paper of 1913 he has given up ultraligation. We feel gratified that our views now coincide with those of an American surgeon who has probably contributed more than any other of his compatriots to the investigation and promotion of the anatomy of the goiter and the thyroid gland.

b. Kocher's method is much more expedient, as it secures greater protection for the

[1] Translated by Dr. H. Parrell

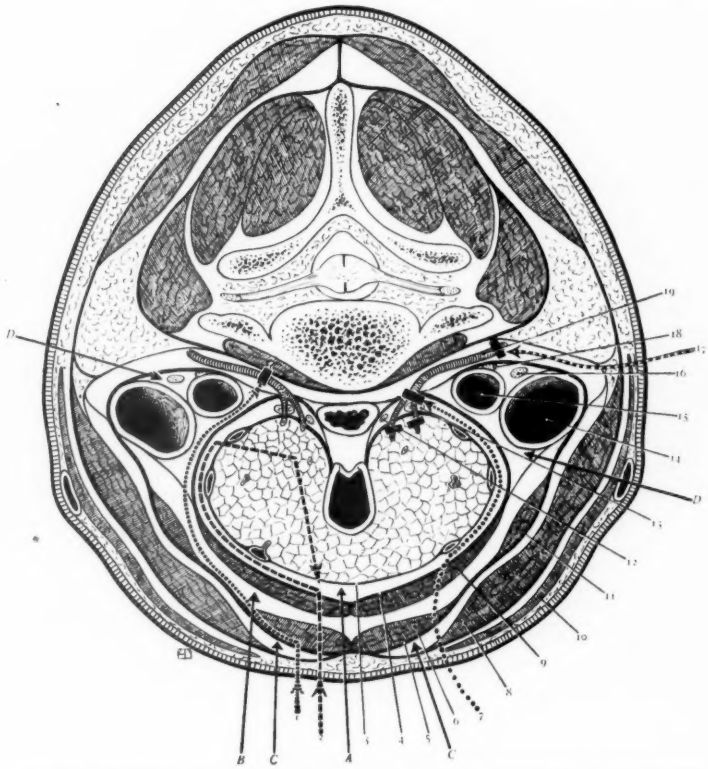


Fig. 1. Schematic outline of the fasciæ and spaces in the region of the thyroid gland obtained by means of injections into cadavers and operating investigations. The fasciæ are depicted by curved lines, more or less thickly drawn, according to their importance.

A thyroid space (spatium thyreoideum); *B* sternohyoid space (spatium sternohoideum); *C* sternomastoid space (spatium sternomastoideum); *D* space containing blood-vessels. The spaces are here schematically outlined as artificially enlarged by the mass injected.

1. Entrance to the inferior thyroid artery for the purpose of extrafascial ligation (de Quervain's method.) *2*. Entrance to the goiter itself when resection or enucleation is intended. *3*. Capsula propria of the thyroid gland (the so-called internal capsule). *4*. Internal fascia of the small muscles: thyroid fascia (the so-called external capsule). *5*. External fascia of the small muscles. *6*. Sternothyroid muscles. *7*. Entrance to the inferior thyroid artery for ordinary goiter operations: viz., (*a*) Billroth's method — Kocher applies the ligature more laterally, but penetrates through the same space; (*b*) Halsted's ultraligation. *8*. Sternocleidomastoid muscle. *9*. Sternothyreoid muscle. *10*. Cutaneus muscle (platysma myoides). *11*. Omohyoid muscle. *12*. Recurrent laryngeal nerve. *13*. Parathyroid glandulæ. *14*. Internal jugular vein. *15*. Common carotid artery. *16*. Pneumogastric nerve. *17*. Entrance to the trunk of the inferior thyroid artery as recommended by Drobnik, Alamartine, Rogers, etc. *18*. Sympathetic nerve. *19*. Inferior thyroid artery.

recurrent nerves and the parathyroids. The ligature is applied after the goiter has been lifted from its bed, in the space between the thyroid gland and the thyroid fascia, but as laterally as possible. One slight disadvantage of this method, however, is that when seeking the artery we are not separated by a layer of fascia from the recurrents and the epithelial bodies; therefore, the care of these two structures demands great attention. The results

Fig. 2. Special instruments for goiter operations. *1*, *2*, and *3* retractors of different sizes; *4*, long blunt dissector; *5*, narrow elevator used for raising and detaching the inferior artery from its surroundings; *6*, fine aneurysm (Cooper's) needle.

hitherto obtained and still obtained by Kocher and many other surgeons by means of this method prove that with sufficient practice the above-mentioned structures may be protected with a good degree of certainty. Still one disadvantage remains; viz., in order to reach the artery the operator must penetrate the space containing the most veins: consequently, there is risk of extensive venous hæmorrhage before reaching the artery, especially in the case of richly vascularized goiters, and more particularly in the case of Graves' disease.

c. Surely then it must be more advantageous to ligate the artery somewhat farther away from the goiter in the space containing the small thyroid muscles, outside the thyroid fascia (the so-called external capsule of the goiter). This is the method we have employed since 1911. Later on we shall describe it more fully.

d. Finally, we can ligate the ascending branch of the artery, as Dietrich first and later Langenbeck seem to have done, *on the outward side of the carotid artery.* To this end Langenbeck incised transversely the sternomastoid muscle, whereas Drobnik, taking into account the regional anatomy, proposed penetrating laterally from the outside border of the above-named muscle, a proposal adopted again later (25 years ago) by Billroth, Rydygier and Woelfler, also by Reverdin, and recently by Alamartine and Rogers. It is clear that in proceeding thus the surgeon intervenes at quite an unnecessary distance from the field of the operation. Moreover, as far back as 1891, Woelfler drew attention to the fact that this method is conducive to lesions of the sympathetic nerves. Old as it is, it does not seem to have found its way into the practice of goiter surgery, and Alamartine's most recent recommendations of it are based only on anatomical considerations. Rogers[1] only has employed it in 37 of his cases.

The foregoing demonstrates that we prefer ligating in the space between the outer plane of the thyroid fascia and the inner side of the carotid artery.

Before entering into further details, we must say a few words about the spaces and fasciæ round about the thyroid gland. By means of gelatine injections we have, in various ways, investigated the thyroid region in cadavers. Mr. E. C. Jones translated in this journal a summary of these investigations, from our article mentioned above. It was, however, unduly ascribed to Poulsen, whom Jones mentioned on account of his investigations of the other fasciæ of the neck, but who has never examined the spaces round about the thyroid gland.

Our method of procedure was as follows: We injected differently colored gelatine into the various interstices round about the thyroid gland of the cadaver. A transverse cut through the neck after the injected mass had hardened, showed us the extension of the different spaces now filled out with gelatine. We devoted another series of experiments to the special study of the fasciæ, proceeding as follows: We injected completely transparent gelatine under high pressure into all the

[1] As far as we can ascertain.

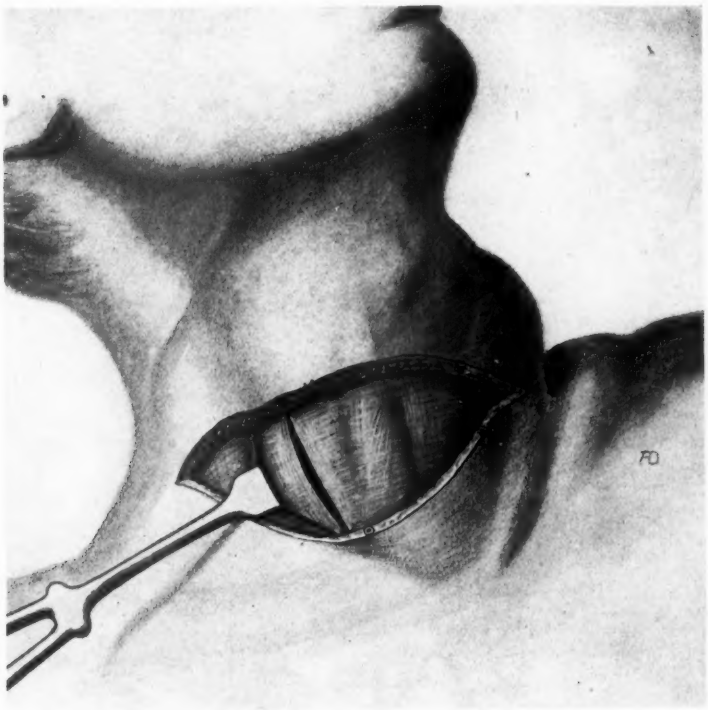


Fig. 3. Skin and platysma incised. Muscle sternocleidomastoideus retracted outward. The external fascia of the small muscles is vertically incised over the sternohyoid muscle.

spaces. We then excised a transverse section 2.5 centimeters thick from the neck, fixed it in Kaiserling's solution, and embedded it in transparent gelatine. Thus we obtained excellent preparations, which had, so to say, been artificially rendered œdematous to such a high degree that the course of the fasciæ could be traced into their very finest layers. The arteries of these preparations were filled at the same time with red, and the veins with the blue gelatine. The anatomical conditions found were the following (Fig. 1):

The thyroid gland is enveloped in a thick layer of its own fibrous tissue, called the capsula propria (according to Kocher, the epithyroideum). This fibrous envelope cannot be detached from the thyroid gland as, for instance, the fibrous capsule can be detached from the kidney, or, to be more exact, it forms an integral part of the gland. The thyroid gland is surrounded by a space containing fine layers of connective tissue and veins. This space, into which only a liquid mass can be injected, is called the *spatium thyreoideum*. In front it is bounded by a layer of fascia; viz., the inner fascia of the sternohyoid muscle which, more laterally, forms the median boundary of the blood-vessel sheath. We adopt for it the same name as Corning and other anatomists, the *thyroid fascia*. It corresponds with what is generally called the *external capsule*. More posteriorly this fascia separates into single lamellæ which take their way to the trachea, the œsophagus, and the spinal column. Around the thyroid fascia we find another space containing muscles; viz., the sternothyroideus, the sternohyoideus, and a portion of the omohyoideus. We call it the *spatium sternohyoideum*. Its outer wall consists of a strong fascia; viz.,

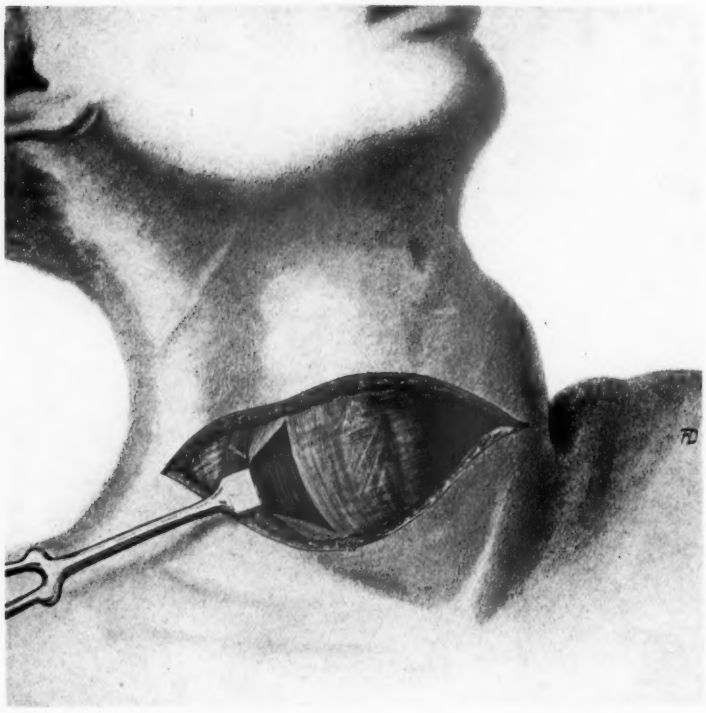


Fig. 4. Small retractor in position. Sternohyoid muscle exposed. The forefinger will now be deeply insinuated in a median direction to seek and expose the inferior thyroid artery.

the outer fascial covering of the sternohyoid muscle. As such it overlays the thyroid region, stretching from there to the rear. On the outer side of this space we have finally the space containing the sternomastoid muscle, the *spatium sternomastoideum*. The blood-vessel sheath lies to the rear of the spatium thyreoideum and the spatium sternohyoideum. The chief component of its median wall is the fascia thyroidea, its anterior outer wall being formed by the fascia thyreohyoidea. Behind the blood-vessel sheath and anteriorly from the profound neck fascia the inferior thyroid artery takes its upward course, penetrating the posterior portion of the thyroid fascia on the median side of the carotid artery. The parathyroids and the recurrents — the latter within the field of operation — are both situated in the spatium thyreoideum. For that reason, and because it contains numerous capsular veins, we avoid the spatium thyreoideum as an entry to the arteria thyreoidea inferior. Therefore we have at our disposal only the spatium sternomastoideum. The last-named space, starting from the median border of the sternomastoid muscle, is the one which has, since the time of Velpeau, Faraboeuf, and Kocher, been noted in surgical textbooks as the best entry for the application of an isolated ligature to the inferior thyroid artery. The operator frees the median border of the sternomastoid muscle and then penetrates between it and the fascia of the sternohyoideus. Certainly the artery sought for can be reached in this way, but the jugular vein is always reached first and is liable to injury if great precaution is not exercised. The following course, which we proposed for the first time in 1911, is therefore very much to be preferred.

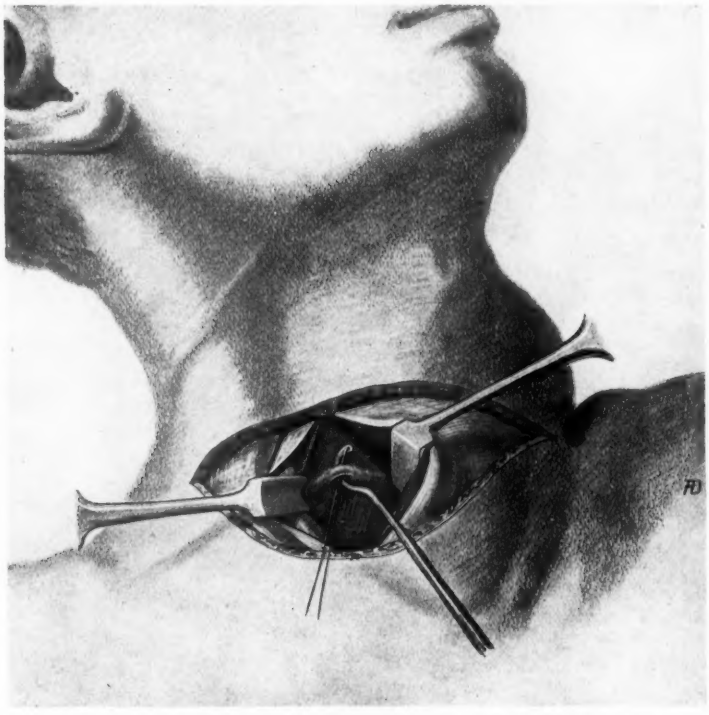


Fig. 5. A larger sized retractor has now been inserted. The inferior thyroid artery has been bluntly disengaged from its surroundings and will now be ligated.

We employ Kocher's collar incision, dividing at one sweep the skin, subcutaneous fat, and platysma myoides. After ligating the superficial veins, we free the median border of the sternocleidomastoideus and draw it so far outward with a blunt retractor that the surface of the anterior fascia of the small muscles becomes visible. We then make a vertical slit of about 2.5 to 3 centimeters long in the latter mentioned fascia (Fig. 3), pare it back bluntly, and catch it up with the retractor (Fig. 4). We now work bluntly with a finger, insinuating it deeply in a median direction, along the median side of the common carotid. This artery we release from its median surroundings, and come into touch, almost immediately, with the arteria thyreoidea inferior, which passes at a right angle to and underneath the carotid artery in a median direction (Fig. 5). If necessary, we now replace the retractors by others reaching somewhat deeper, so as to bring the artery into view, and, with the aid of two long, blunt dissectors, 17 centimeters in length (Fig. 2), separate and raise it from the deep neck fascia with a narrow elevator we have had made especially for the purpose (Fig. 2). The ligature thread is now slipped round the artery with an especially lightly constructed Cooper's needle. In simple cases the whole proceeding, from the skin-cut to the tying of the ligature, does not take more than a few minutes.[1]

As a rule, no vein whatever, except one or two surface veins, interferes with the application of the ligature. In other cases the vena thyreoidea media crosses the arteria thyreoidea inferior. However, the operator is rarely obliged to ligate the vein in order to gain access to the artery.

[1] This method was briefly translated from my paper and published in Surg., Gynec. & Obst., 1913, xvii, 642, by E. O. Jones, but its origin was not cited.

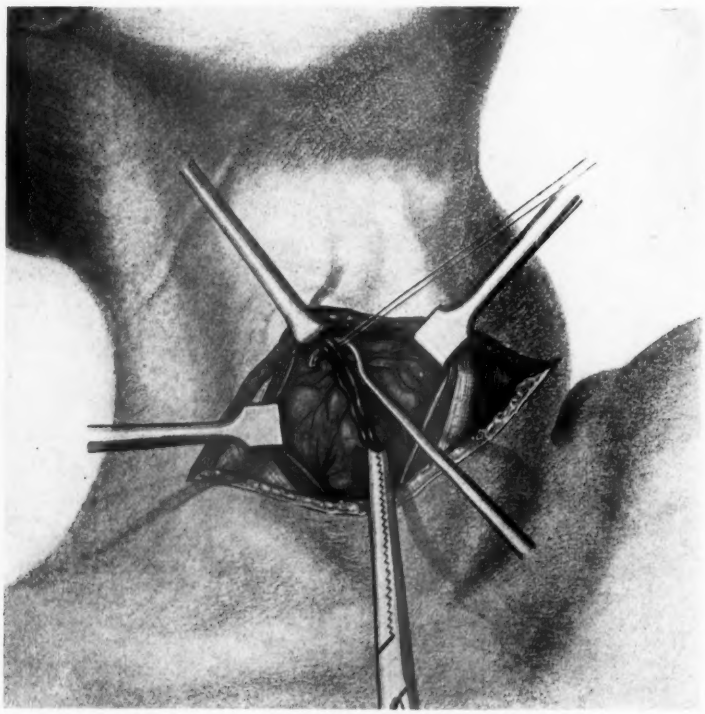


Fig. 6. Spatium sternohyoideum is dissected and access is now obtained somewhat more medianly, through the small muscles and the thyroid fascia immediately in front of the thyroid gland (in the spatium thyreoideum). The goiter is retracted downward before luxating it, in order to ligate the superior thyroid artery or its anterior branch.

The ligature applied, the question arises as to whether the goiter itself requires surgical treatment. If so, we leave our space, work our way in between the small muscles (Fig. 7), free the goiter whose capsular veins now hardly bleed at all, luxate the goiter, and undertake whatever the existing circumstances demand; excision, resection, or enucleation, as shown in the accompanying illustration (Figs. 7 to 9).

The inferior thyroid artery being, as we know, somewhat less regularly existent than the superior, and its course also less regular, we ask ourselves how often the ligature can be applied in the above-described manner. During the first period, in which we operated on these lines, it was possible in 89 out of a hundred cases. In a later series, we met with no obstacle in 95 out of a hundred cases. In only 5 cases was the ligature impossible, owing to the non-existence of the inferior thyroid artery, or to its too profound situation.

The only real difficulties in the way of applying the ligature in the above-described manner occur when, for instance, the artery is situated too far thoraxward, or is too far overlapped by the goiter. In most cases the two obstacles may be overcome by using sufficiently long, suitably constructed retractors. Sometimes the operator is surprised during the subsequent goiter operation by an unexpectedly strong hæmorrhage, after having, as he supposes, accurately ligated the artery. The reason of this is generally that the ligature has only been applied to the superior branch of an inferior thyroid artery which divides abnormally near to its origin. In reality this occurs

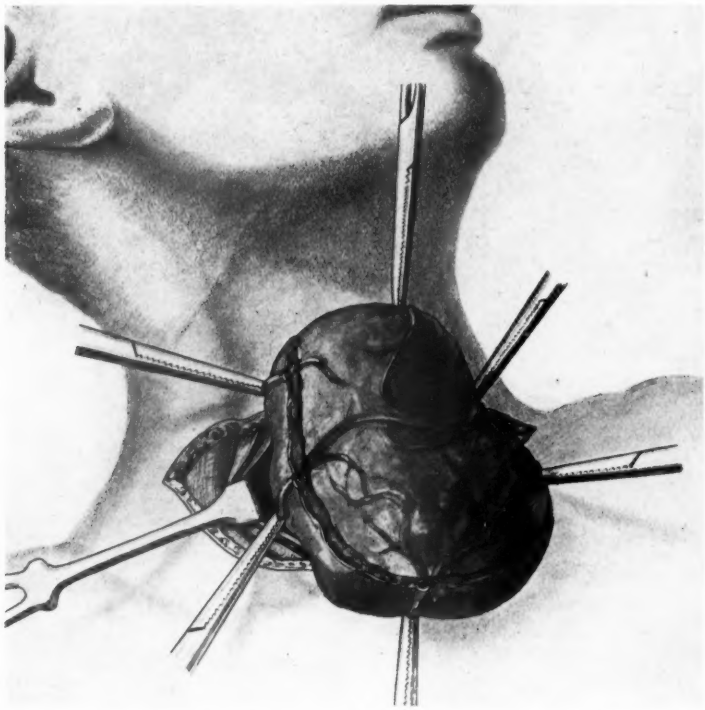


Fig. 7. Goiter luxated. Clamps are applied to the larger veins. The portion to be resected is shown by a circular incision.

much less frequently than certain anatomical investigations would lead us to expect.

One condition demands attention, as it may lead to most unpleasant results; for instance, it may happen that when the surgeon is about to slip the Cooper's needle around an inadequately separated artery, or has inadvertently tied the ligature too tightly, a brittle vessel tears, or is cut through, and it is not always easy to locate the vessel again. This, of course, is more likely to occur in the case of older persons, or persons with Graves' disease. These unfortunate circumstances may all be avoided by carefully isolating the artery with two blunt dissectors and the narrow elevator, and by not drawing the ligature thread too tightly. In the case of brittle arteries it is advisable to employ strong catgut.

The neighboring organs and structures to be considered are: the *recurrent laryngeal nerves*, the *parathyroid glandules*, and the *sympathetic nerves*.

The shielding of the *recurrent nerve* is easy, as, at the level of the ligature, it is separated from the artery by the previously described thyroid fascia, and is invisible during the whole operation, which is one of the chief advantages of my method.

Of the 370 goiters we operated upon from the beginning of July 1911 until the end of August 1913, we had the opportunity of examining at a later date 250 cases, and especially of ascertaining the exact condition of the vocal chords. Among the 197 cases operated on according to my method (comprising 276 ligatures of the inferior artery), only *one* case of permanent paralysis of the recurrent nerve had occurred, and that not in consequence of the ligature, but of the shelling out of a cyst, between which and the posterior capsule firm adhesions had to be

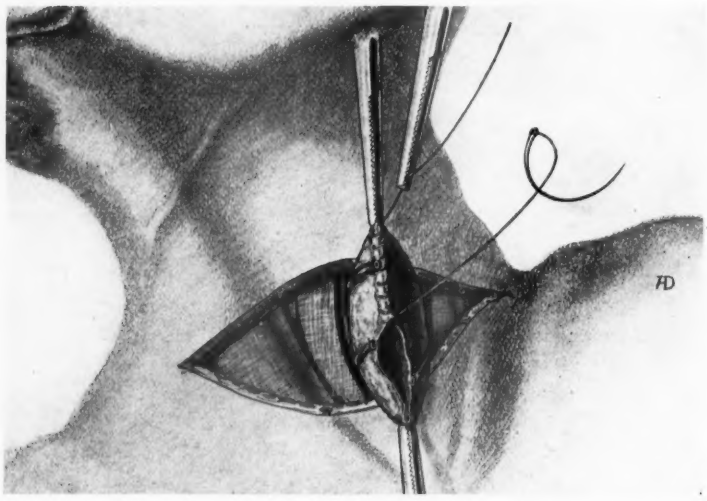


Fig. 8. Goiter removed by means of resection, enucleation, or combination of both. The largest veins and the anterior branch of the superior thyroid artery are ligated. The smaller veins have been drawn into the hæmostatic suture. A lobe of almost normal size has been formed out of the remaining gland tissue.

severed. Two further cases of permanent paralysis of the vocal chords occurred after operations on the old lines (intrafascial ligation of the artery). In 8 cases we found paresis such as any method may occasion through stretching of the nerve during the process of luxating the goiter. All these 8 cases of paresis were on their way to recovery. The cause of these paretic conditions was not always to be determined with any amount of certainty. Particulars of the cases will be found in my recent paper, and in that of my assistant, Dr. Hoessly, in the *Deutsche Zeitschrift fuer Chirurgie*, December, 1915. The chief point is that among 250 goiter operations only 3 cases of permanent injury to the recurrent nerve occurred, and that of these 3 only 1 occurred among the 197 cases operated on with the new method.

Secondly, the parathyroids must be protected. The thorough investigations, notably of Erdheim, Halsted, Geis, Evans, Bérard, Alamartine, and Iversen, with regard to the blood supply of these organs, prove that each of them is supplied by a fine branch of the arteria thyreoidea inferior, or by the branch artery connecting the inferior with the arteria thyreoidea superior. A little simple reasoning will make it clear that this fine blood supply can most effectually be protected by ligating the large arterial trunks as far away from it as possible. This course alone insures the safety of the fine arteriæ parathyreoideæ during the operation, and provides as large a field as possible for the collateral circulation. Therefore, the farther away from the thyroid gland a ligature is applied to the inferior thyroid artery, the less the danger of injury to the parathyroids. For the past five years I have advocated this principle and am glad to see that it is becoming more and more recognized. Up to the present I have, in more than 200 cases, tied both the inferior thyroid arteries at one sitting, and have never seen a trace of tetany. Neither have I found this condition in the numerous cases, in which I have simultaneously ligated three arteries, or when ligating the two inferiors, one superior, and the front branch of the other superior thyroid artery. We can, therefore, say that tetany is not the result of the ligature itself, but the result of a ligature improperly applied.

The third organ demanding protection is

the sympathetic nerve. Hitherto it has received but little attention, and many surgeons have severed it with therapeutic intent in cases of Graves' disease, without considering the far from pleasant consequences of a sympathetic paralysis, especially the consequences of a sympathetic ptosis and miosis. Just the last named symptoms demonstrate the desirability of shielding the sympathicus, especially when Graves' disease is not the cause of the goiter. In such cases nothing could justify a lesion to the nerve. Our investigations show that the sympathetic nerve is somewhat more endangered by our method of ligation than by the older method. Certainly more exact investigations on injuries to the sympathetic nerve in the course of other methods of goiter operation are lacking. It is principally in danger of being crushed by the retractor used to draw the carotid outward. Among the 250 cases we subsequently examined there was only one of decided sympathetic paralysis, and three with slight pareses. In several cases the nerve was defective before the operation. These figures show that the danger is not great. At my request Professor Metzner and Dr. Woelfflin have investigated the sensibility of the sympathetic nerve with regard to traumatic lesions, and have found that in the case of rabbits a traction of 10 grams a minute is the maximum that can be endured without a reaction on the part of the nerve. An increase in weight of 15 to 20 grams produced regularly vascular and ocular pupillary symptoms, the latter of which completely disappeared in only a few cases. Still, in order to reduce even this slight danger, I have constructed the retractor I employ for drawing outward the carotid artery in such a manner that it does not rest on the vertebral column with a long edge but with only two supporting knobs. Thus the risk of nerve lesion is but slight (Fig. 2, *1*).

We will now proceed to the ligation of the arteria thyreoidea superior. On this point there exists less difference of opinion. We therefore will also treat it briefly. If only one of the superiors is to be ligated, it can be done from a short transverse cut made precisely in the line of the skin-folds at a level with the thyroid cartilage. If the two superiors are to be occluded, a corresponding cut is made on the other side and the operation carried out in the same manner, whether it be a question of pure arterial or pole ligation. If, however, in addition to the superiors, the inferiors and the goiter itself are to be included in the operation, all can be done, as Tavel was the first to prove, ligation of superior and inferior arteries, lobectomy, etc., from the usual collar-incision. The entry this incision provides is ample for the ligation of the superiors, if only the upper skin-flap is drawn sufficiently high upward, and the small muscles retracted outward and upward (Fig. 6). As a rule, it is quite unnecessary to luxate the goiter before applying the ligatures. On the contrary, we generally ligate the superior thyroid arteries before dislocating the goiter, whether we restrict ourselves to ligatures, or undertake further intervention (Fig. 6).

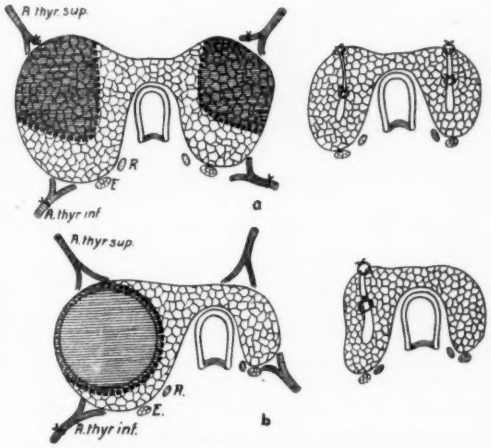


Fig. 9. Plan of the goiter operation. *A* (above), Resection of both lobes, *B* one-sided enucleation, *R* recurrent nerve, *E* epithelial bodies.

The question now arises as to how many arteries should and may be ligated. That depends entirely upon the object in view. If a diffuse goiter or, more particularly, a goiter caused by Graves' disease is to be treated *with ligation only*, the surgeon should not be too timid. Ligatures applied to only two arteries, whichever they may be, do not seem to me sufficient to attain a lasting effect, even if the primary result appears satisfactory.

For that reason I always ligate preferably at one operation, more rarely at two, three to three and one-half arteries; i.e., all the thyroid arteries with the exception of one superior, or the posterior branch of one. This operation, if properly carried out, will by no means interfere with the function of the parathyroids. According to the results of different surgeons their function does not appear to have suffered, even after the occlusion of all four thyroid arteries (Rogers). Still, for my part, I have, until now, preferred to confine my ligatures to three and one-half arteries. We know for certain that ligation is only efficacious in cases of diffuse, and especially of extremely vascular goiters, and is even then not to be completely depended on. My later examinations of patients operated on have convinced me that only small diffuse goiters recede sufficiently. Medium sized goiters certainly do shrink a good deal; they cannot, however, be reduced by ligation alone to anything like the ordinary volume of a normal thyroid gland. The collateral circulation between the thyroid gland and its neighboring organs is, in spite of the absence of a more extensive arterial communication, so plentiful that the gland remains viable even after the occlusion of all four arteries, if only it is not too radically separated from the surrounding structures. Experiments on animals have also proved this fact.

In conclusion we have to consider *the value of ligation in the various goiter operations.* We have employed it extensively in our surgical practice, and are more and more convinced as to its advantages. It is understood that many operations, especially enucleation, can also be easily performed without preliminary ligation. It has, in fact, been laid down as an axiom that enucleation should be undertaken without preliminary ligation, so as to preserve as much healthy gland tissue as possible. This conception originated in an undervaluation of the advantages of preliminary hæmostasis, and especially in an undervaluation of the importance of the collateral circulation as a source of nourishment for the thyroid gland. Now we know that the supply of blood to the remaining tissue of a thyroid lobe operated on is not endangered by the ligation of an inferior, if only the posterior branch of a superior is left intact, and if we do not unnecessarily sever the isthmus with its border arteries. Our subsequent examinations of cases operated on have indeed proved that the preservation of the isthmus (Fig. 9), provided this organ is not decidedly diseased, in no way impairs the result of the operation. Therefore, in the 250 cases reported in our statistics, we did not once completely sever the isthmus. In only 29 cases, in which it was in an advanced goitrous condition, did we partially remove it. By the preliminary ligation of an inferior — this is generally the more important artery — enucleation becomes a much less sanguinary, a clearer, and a neater operation. At the same time we can avoid hasty clamping and too extensive pouch sutures when surprised by unexpected deep hæmorrhage, both of which steps mean grave risk for the recurrent nerve. If both lobes contain larger nodules the preliminary ligation of both the inferior arteries permit us to shell out neatly the largest nodules from both lobes, instead of restricting the operation to the more simple, but less logical excision of one whole lobe, which always places the surgeon in a quandary if later he is called on to intervene further in consequence of the disturbance caused by the goitrous condition of the other lobe.

The foregoing remarks apply still more particularly to the operation of diffuse colloid goiters. The ideal method is then reduction of both lobes by means of resection which can be achieved without unnecessary loss of blood only by preliminarily ligating arteries on both sides. Then again it is better to ligate the inferiors, so as not to risk injuring the recurrent laryngeal nerve. If the inferiors and the anterior branches of the superiors are ligated on both sides, the operation can, in most cases, be performed calmly and without hæmorrhage, and an adequate supply of blood is insured for the remaining thyroid tissue and the parathyroid glandules.

THE RELATION OF ARTERIOSCLEROSIS AND OTHER ANATOMICAL CHANGES OF OLD AGE TO THE DEVELOPMENT OF EPITHELIAL MALIGNANCY[1]

A Study of 206 Cases of Carcinomata

By FRANK WARNER, M.D., F.A.C.S., Columbus, Ohio

IN treating of the so-called precancerous conditions, various authors have presented us with an amazing amount of literature during the past decade. As a result of these studies, one practical result has followed. The surgeon has been enabled to see and treat his cancer patients much earlier than before. Less mutilation has followed these earlier operations and many lives have been saved that before would have been lost.

Bloodgood[2] and others have presented the clinical picture of those breasts whose epithelial cells are about to take on, or recently have taken on, an abnormal growth. He has given the surgeon a very tangible and useful description by which he may recognize those conditions of the lip which, if not promptly and radically treated, will destroy the patients' life.

From a histological study of these precancerous conditions, a number of research workers, including Greenough and Hartwell,[3] Speese,[4] Klotz,[5] MacCarty,[6] Means and Forman,[7] have confirmed this work of Bloodgood, and are agreed that the essential anatomical changes in these conditions are—

1. Increased activity on the part of the epithelium.

2. Increase in the connective tissue, especially in the amount of intercellular substances elaborated.

3. And, lastly, an obliteration of the lumen of the blood-vessels.

It is to be noted that a majority of the workers have been intent upon a search for landmarks by which the surgical pathologist might recognize the malignant change before actual penetration and infiltration had taken place. Some of them, however, have attempted to submit theories to explain how these anatomic changes might so disturb nutrition as to become factors in the production of carcinoma.

In a study of the only cancers which have been produced "experimentally," Wyss[8] and Wolbach[9] are agreed that such cancers are the result of altered nutrition, and this in turn is dependent upon a narrowing or obliteration of the lumen of the subepithelial blood-vessels supplying a certain group of cells. This condition follows X-ray burns.

Theilhaber[10] has placed great stress upon certain old age conditions as causative factors in the production of carcinoma.

Chief among these old age conditions having an etiological role he places endarteritis. He says: "When organs which have been invaded by cancer are examined, one usually finds in the connective tissue about the growth very few cells, blood-vessels which are stenosed and with thickened walls, and signs of endarteritis obliterans. An exception to this is noted, however, in that the tissues immediately surrounding the cancer show a more or less marked reactive hyperæmia with cell-infiltration usually of slight degree.

. . . I drew the conclusion," he continues, "from these and many similar observations that the local disposition of aging tissue to cancer results from a diminution of the cellular elements and a contraction of the blood-vessels in the connective tissue."

In discussing these anatomic changes which are assigned by some of these workers an etiological role in the production of carcinoma, Loeb[11] said: "Some accuse the ob-

[2] Bloodgood. Surg., Gynec. & Obst., 1914, xviii, 19.
[3] Greenough and Hartwell. J Med. Research, xv, 416.
[4] Speese. Ann. Surg., Phila., 1910, Feb., 213.
[5] Klotz. Canadian M. Ass. J., 1912, May.
[6] MacCarty. Surg., Gynec. & Obst., 1913, xvii, 41.
[7] Means and Forman. Ohio St. M. J., 1914, June.
[7] Idem. Dental Summary, 1915, Dec.
[8] Wyss. Muenchen. med. Wchnschr., 1907, liv, 1576.
[9] Wolbach. The Fifth Report of the Cancer Commission of Harvard University, 89.
[10] Theilhaber. Surg., Gynec. & Obst., 1914, xix, 650.
[11] Loeb. J. Am. M. Ass., 1910, Sept.

[1] Read before the B. Merrill Ricketts Experimental Surgical Research Laboratory, Cincinnati, Ohio, February 19, 1916.

literation of the blood-vessels; this condition it was argued forced the epithelial cells to obtain their food supply from the connective-tissue cells; which latter process was said to act in a similar manner as the penetration of a spermatozoon into an ovum, a somewhat fantastic comparison with barely any foundation of fact.

"Others assumed," he continues, "that chronic connective-tissue changes liberated the latent energy of the epidermis. It is, however, difficult to see why very dense connective tissue should, as such, be favorable to epithelial growth. In all probability," he concludes, "it would prove very resistant to the expansion of the epithelium." He dismisses the etiological importance of this fibrosis with the observation that "in many cases of cancer of the skin no such changes are found."

With this variation of opinion in mind, it would seem desirable to take as large a number of carcinomata as time would permit, and study them to ascertain whether these anatomic changes were at all a constant accompaniment of cancer. This is such a study, based upon the examination of 206 cases of carcinoma. Their distribution can be seen in the appended table (see Table I).

Since most of the workers mentioned above have concerned themselves with carcinoma of the skin, the epidermoid type will be considered first. The histological study of the condition of the tissues involved in the epidermoid carcinomata revealed, in many instances, a distinct stenosis of the lumen of the arteries supplying the part, and frequently a like condition in the smaller vessels. In this study, consideration has been given only to those cases in which the arterial changes have produced a stenosis of such pronounced type as would indicate that it probably antedated the development of the cancer, and of such a degree as to be capable of interfering materially with the nutrition of the area involved.

The percentage of cases in which these anatomic changes were present varies with different sites studied. Whether these figures would hold if a larger series were examined is somewhat doubtful.

Seventy-six epidermoid carcinomata, occurring in various parts of the body, were examined. Of these 76 cases, 44, or 57.64 per cent, showed a distinct obliterative change in the lumen of the arteries. The connective tissue surrounding 47 cancers, 61.57 per cent, of this series was characterized by the presence of few nuclei and a rather large amount of intercellular substance. There was a marked lymphocytic infiltration present in 57, or 76 per cent, of the specimens.

While this series is not a large one, yet it does show one thing; namely, that these anatomic changes (obliteration of blood-vessels and fibrosis) are not constant in epidermoid carcinomata. It would, therefore, not appear safe to place too great stress upon their etiologic role in the production of this type of carcinoma.

Since arterial changes are known to occur so frequently in the uterus, it seemed best to examine a series of non-cancerous cervices from patients of the cancerous age as a control. Twenty specimens from women over 35, which had been removed because of erosions or scars, were studied.

Of the 20 cases examined, 8, or 40 per cent, presented endarteritis, leaving 12, or 60 per cent, normal vessels. Nine, or 45 per cent, had an acellular stroma, 3 of these without connective-tissue increase, and 6 with fibrosis. Four, or 20 per cent, were infiltrated with lymphocytes.

If this control series is compared with the cancers of the cervix, it will be found that 79 per cent had sclerosed vessels in the cancers and 40 per cent in the non-cancerous cervices; an acellular stroma in 50 per cent of cancers, and 45 in the non-cancerous cases; a lymphocytic infiltration of 79 per cent in the cancers and 20 per cent in the benign cervices.

HAIR MATRIX CARCINOMATA

Thirteen hair matrix carcinomata were studied. Eleven of these cases were from the face, on or above the upper lip, which is quite characteristic of this form of cancer. Occasionally they do arise in other parts of the body, as in these cases one was from the region over the scapula, and another from the leg.

TABLE I

	Number of Cases	Vascular Obliteration	Connective-tissue Increase	Lymphocytic Infiltration
Epidermoid carcinomata of—				
Hand	6	5 or 85 per cent	4 or 66.6 per cent	5 or 85 per cent
Nipple	1	1 or 100 per cent	1 or 100 per cent	1 or 100 per cent
Over thigh	1	0	1 or 100 per cent	1 or 100 per cent
Foot	2	2 or 100 per cent	1 or 50 per cent	2 or 100 per cent
Anus	1	1 or 100 per cent	1 or 100 per cent	1 or 100 per cent
Penis	3	0	2 or 66.6 per cent	3 or 100 per cent
Vagina	5	3 or 60 per cent	3 or 60 per cent	4 or 80 per cent
Cervix uteri	24	19 or 79 per cent	12 or 50 per cent	17 or 71 per cent
Face	6	3 or 50 per cent	3 or 50 per cent	4 or 60 per cent
Oral cavity	6	3 or 50 per cent	3 or 50 per cent	4 or 60 per cent
Lower lip	15	4 or 27 per cent	10 or 66 per cent	10 or 66 per cent
Œsophagus	1	0	1 or 100 per cent	0
Elsewhere	5	3 or 60 per cent	4 or 80 per cent	5 or 100 per cent
Total	76	44	46	57
Hair matrix carcinomata	13	5 or 38 per cent	10 or 76 per cent	2 or 15 per cent
Carcinomata of stomach	17	6 or 35.5 per cent	4 or 23.5 per cent	4 or 23.5 per cent
Adenocarcinomata found elsewhere in digestive tract	12	8 or 66.6 per cent	5 or 42.5 per cent	3 or 25.5 per cent
Carcinomata of the ovary	10	3 or 30 per cent	1 or 10 per cent	3 or 30 per cent
Adenocarcinomata of uterus	8	5 or 62.5 per cent	2 or 25 per cent	3 or 37.5 per cent
Series of non-cancerous uteri	9	3 or 33.3 per cent	1 or 11.1 per cent	0
Carcinomata of the prostate	12	4 or 33.3 per cent	3 or 25 per cent	9 or 75 per cent
Hypertrophies of the prostate	10	1 or 10 per cent	2 or 20 per cent	6 or 60 per cent
Cancer of the breast	50	29 or 58 per cent	46 or 92 per cent	4 or 8 per cent
Abnormal involution of breast	24	6 or 25 per cent	24 or 100 per cent	16 or 66.6 per cent
Carcinomata of lung	4	0	1 or 25 per cent	0
Carcinomata of liver	4	1 or 25 per cent	0	0
Total number of carcinomata	206	105 or 50.0 per cent	118 or 57 per cent	85 or 41 per cent

This type of cancer arises, as the name implies, from the epithelial cells of the hair follicle. In their growth, tumor-cells of this type tend to differentiate as do the cells of the hair matrix and form the characteristic fibrils (Mallory[1]).

They also tend to form tubules, as would be expected from their origin. The cells themselves are frequently spindled celled or cuboidal, and often appear in a rather compact arrangement.

Hair matrix carcinomata seldom invade the deeper structures and so are perhaps less malignant than any other type of carcinoma. If removed by a rather wide incision, they are not likely to recur. This is shown by two of my own cases in this series, one of which was removed some five years ago and the other two years, without signs of recurrence in either instance.

In the examination of this group of 13 hair matrix carcinomata, 10 of the cases showed a dense connective tissue beneath the epithelium and surrounding the hair-follicles, which was poor in nuclei and rich in intercellular substances. Arterial stenosis was noted in only 5, or 38.5 per cent, instances; and 2, or 15.4 per cent, of the cases presented lymphocytic infiltration.

[1] Mallory. Histologic Pathology, p. 371.

CANCER OF THE BREAST

Fifty cases of carcinoma of the breast were examined. In 29, or 58 per cent, vascular changes of a degree sufficient to be capable of interfering with the blood supply to the part were revealed.

Since the epithelium of the breast seems to possess the power of stimulating the growth of connective tissue, even to a marked extent in the benign tumors (the so-called fibro-epithelial tumors, or adenomata), it was not surprising to find connective-tissue increase in all of these cancers except the most cellular and rapidly growing ones. Out of the entire group of 50 cancers of the breast, there were but 4, those of a medullary type, that did not show fibrotic changes.

In a control series of 24 specimens of abnormal involution of the breast, only 6 cases, 25 per cent, presented arterial sclerotic changes, and 16, 66.67 per cent, with infiltration of lymphocytes.

All of the control series exhibited fibrosis, as this is a part of the histologic picture of an involuting breast.

From the fact that cancer of the breast is so frequently associated with abnormally involuting breasts, many clinicians and pathologists have come to regard this state of the gland as a precancerous condition requiring removal of the organ.

The vascular changes in the cancers were 58 per cent compared with 25 per cent of sclerosed arteries in the non-cancerous specimens, and there was infiltration of lymphocytes in only 16, 66.67 per cent, cases in the controls.

In studying the specimens of abnormal involution of the breast with reference to the anatomic changes of endarteritis, fibrosis, and epithelial proliferation, it was found that the acini were not only increased in number, but frequently the fibrotic changes were so marked that their secondary contraction had occluded the ducts, resulting in a formation of cysts, which has given rise to the more common term of chronic cystic mastitis.

Often the acini and ducts were filled with proliferating cells, but by carefully examining the surrounding connective tissue, it was plain that there had been no infiltration with epithelium. Not alone that, but the acini, although greatly increased in number, were more uniform in size than when the breast had taken on a malignant type of growth.

ADENOCARCINOMA OF THE UTERUS

A series of 8 cases of adenocarcinoma of the body of the uterus were examined. Five cases, 62.5 per cent, presented arterial obstructive changes; 2, 25 per cent, were acellular; 3, 37.5 per cent, had been infiltrated with lymphocytes.

A study of nine cases of non-malignant uteri of the cancerous age was made. The uteri had been removed for various reasons other than cancer. Three, 33.3 per cent, presented sclerotic vessels; one, 11.1 per cent, gave an acellular connective tissue, but there was no lymphocytic infiltration in any of the 9 cases.

As will be noticed from this series, the percentage of vessels sclerosed was less than in the preceding cancerous series of uteri, although there they were involved in a little more than half of the cases. The same observation is true with reference to the condition of the connective tissue in the region of the carcinoma.

THE PROSTATE GLAND

Twelve cases of cancer of the prostate were examined. Four, 33.33 per cent, of these specimens had been attacked by arteriosclerosis, and 3, 25 per cent, showed the connective tissue to have been increased in amount and exhibiting few nuclei. Lymphocytic infiltration was present in 9 cases, 75 per cent.

McGrath[1] has called attention to the analogy which exists between the microscopical pictures of the epithelial changes in the cancerous process of the breast and prostate. While this study does not assign much etiologic role to vascular stenosis, it leads to an agreement with McGrath as to the nature of the process in both of the organs mentioned. Whatever stimulus initiates the process, it passes through a gradation of epithelial hyperplasia which is often easily followed in a single case. Frequently the various steps may be seen in the same slide. Acini are seen in which both the inner and outer layers of cells are distinct (the primary hyperplasia of MacCarty). Other areas of acini exhibit a filling up with epithelial cells by a proliferation (secondary hyperplasia), and finally areas are found in which the epithelium has broken through and is infiltrating the surrounding tissue (tertiary hyperplasia).

CONTROL SERIES OF HYPERTROPHIED PROSTATES

Ten cases of hypertrophied prostates were examined. The average age of these patients was 60.7 years. Seven of the prostates were cystic in type. But one of the cases showed obstructive sclerotic changes in the vessels. Hyaline degeneration was manifest in a number of the arteries of the specimen. Two of the prostates, 20 per cent, showed acellular connective tissue increased in amount. Six, 60 per cent, presented lymphocytic infiltration.

By a comparison of the hypertrophied with the carcinomatous prostates studied, one finds 10 per cent of the former with sclerosed

[1] McGrath. J. Am. M. Ass., lxiii, 1012.

vessels, while the latter shows 33 per cent with arterial obstructive changes.

In the hypertrophies, 20 per cent showed connective-tissue increase of an acellular type, while 25 per cent of the cancers of the same organ showed a like fibrotic change. Lymphocytic infiltration was present in 60 per cent of the hypertrophies and 75 per cent of the cancerous prostates.

If obstructive endarteritis is one of the occasionally contributing factors in the development of cancer, it was absent in 8 cases, 66.66 per cent, which had normal vessels out of the 12 specimens examined. The same holds true of the cancerous prostates in which fibrotic changes were present, for 75 per cent of them presented a normal connective tissue.

CARCINOMA OF THE OVARY

A series of 10 carcinomata of the ovary were examined. Three, or 30 per cent, showed vascular changes of an obstructive character. But 1, 10 per cent, presented acellular fibrotic changes in the connective tissue. Lymphocytic infiltration was present in 3 of the cases, 30 per cent.

A peculiar feature of this series was the large percentage, 70 per cent, of cases with normal blood-vessels. Another notable fact was the absence of fibrotic changes in the ovary except in a single case of the series. These facts stand out with increased force when we come to reflect that it is a very common thing to find ovaries, removed for other causes in the so-called cancerous age, permeated with sclerosed vessels; also, to find frequently fibrotic changes in these organs. But here are 7 out of 10 cases with normal vessels in the presence of cancer, and only 1 with fibrotic change, while there are numberless cases of ovaries with sclerosed vessels and fibrotic changes without carcinoma. The type of the tumor might influence the findings somewhat, as 7 of these were papillary cystadenomata.

CARCINOMA OF THE STOMACH

Seventeen cases of carcinoma of the stomach were examined. Six, or 35.52 per cent, presented sclerotic arteries; a very low percentage compared with what obtained in carcinoma of the cervix uteri. Four, 23.52 per cent, showed lymphocytic infiltration, which is small compared with some other localities. Four gave an acellular connective tissue increased in amount, 23.52 per cent.

A very interesting question in regard to these cancers is whether they develop from preceding ulcers of the stomach or the ulcer develops from the carcinoma. By analogy we should expect to see a carcinoma develop from the fibrous tissue about an ulcer, just as a cancer frequently develops from the fibrous tissue of an involuting breast, and from the dense tissue following X-ray burns. We are all familiar with Mayo's views that cancer frequently develops from an ulcer. Upon the other hand, Stromeyer thinks the majority of these ulcers associated with carcinoma have been entirely secondary to the cancer, and have been superimposed upon it (Figs. 9 and 10).

The small series of twelve cases of adenocarcinoma of the intestinal tract, other than the stomach, were examined. Eight, 67 per cent, showed arterial obstructive changes; 5, 42.57 per cent, a fibrotic change; and 3, 25.57 per cent, lymphocytic infiltration. One of the specimens was from the œsophagus, two from the ileum, and three from the colon. Of the 6 cases of the rectum included in the above series, there were 50 per cent with arterial changes, one fibrotic, and 2 with lymphocytic infiltration. In 5 of the cases of this series, the cancer-cells had shown their ability to stimulate the connective-tissue overgrowth to an extent that had resulted in an almost complete obstruction of the alimentary tract when this excessive tissue underwent contraction; for whenever newly formed connective tissue in a circular tube undergoes contraction, as it will, stricture results. But this is a feature that is outside the discussion of this study of the etiology of cancer.

PRIMARY CARCINOMA OF THE LIVER

Four cases of primary carcinoma of the liver were examined. But one of these cases showed arterial alteration of its coats, and no fibrotic changes were present in any of them.

The rarity of the occurrence of primary carcinoma of the liver renders these cases of especial interest. This is the more true, since there has been so much written concerning the relation of cirrhosis to primary cancer of the liver. Many authors have emphasized the presence of cirrhosis in this type of cancer in a large percentage of the cases reported.

Winternitz,[1] after quoting a number of writers who had presented tables showing the large number of carcinomata which had been associated with cirrhosis, says: "This table is of interest, since it points out first what a large number of cases of cancer of the liver are associated with cirrhosis, and second . . . . the tumor may occur in normal and diseased livers. In a tremendous percentage of cases the liver presents an ordinary type of cirrhosis. . . . . It is generally agreed that the cirrhosis precedes the neoplastic formation where these two are associated. The tumor, however, brings about pressure atrophy directly and necrosis of the hepatic parenchyma through its excessive vascular involvement, and in this way a fibrosis may result secondary to the tumor growth. This is important, since in a few cases those areas of liver uninvolved by tumor growth are likewise free of cirrhosis. Whether a cirrhosis may develop secondary to the tumor growth is uncertain, but there is no doubt that the cirrhotic process is exaggerated as a result of this. . . . That cirrhosis is more frequently associated with cancers arising from the liver-cells than with those arising from the duct epithelium."

In the series of 4 cases studied by me, the cancer arose in 2 cases from the epithelium of the bile-ducts, and in 2 cases from the liver-cell epithelium. There was no cirrhosis in any of the cases. In one of the patients, 9 years old, he was too young, of course, to have developed cirrhosis from the usual causes.

So, whatever may be the cause of primary carcinoma of the liver, neither vascular changes nor fibrosis could be charged as a causative factor in these 4 cases.

[1] M. C. Winternitz. Primary carcinoma of the liver. Johns Hopkins Hosp. Reports, N. S. No. 3.

PRIMARY CARCINOMA OF THE LUNGS

The very respectable series of 4 cases of primary carcinoma of the lungs were examined. Owing to the rarity of the trouble, or seeming rarity, I felt I was fortunate in finding 4 cases put at my disposal for study in the Laboratory of Pathology of the Ohio State University. A report of these cases has already been prepared for publication.

None of these cases had any vascular changes nor lymphocytic infiltration. But one of them was associated with fibrosis. This one was an epidermoid carcinoma, apparently taking its origin from the bronchial mucous membrane.

An interesting question at once arose as to how squamous epithelium forming the cancer could come from the ciliated cylindrical epithelium of the mucous membrane lining the bronchial tubes. The answer comes from the belief in the metaplasia of one type of cell of a tissue into another type of the same tissue.

Virchow, in 1854, propounded the theory of the metaplasia of cells of any type into cells of other types. Metaplasia occurs only within certain limits. Epithelial tissue can be converted into other forms of epithelial tissue; one form of mesoblast into another form of mesoblastic tissue.

Adler[2] in his monograph says: "The transformation of one sort of epithelium into another, usually of cylindrical or cuboid epithelium into squamous epithelium, as has been found in many kinds of inflammatory processes . . . . is well known . . . . The theory of persisting and abnormally dispersed germinal centers and remnants, while it cannot be disproved, is not necessary for the explanation of the so-called metaplastic transformations."

Haythorn[3] observes: "During the study of a case of unresolved pneumonia, one field was found which contained two medium-sized bronchi, the mucosa of which was replaced by granulation tissue covered by stratified squamous epithelium. Then as many as twelve bronchi were found which showed a like condition." He concludes: "Our find-

[2] Adler. Primary Malignant Growths of the Lungs.
[3] Samuel R. Haythorn. J. Med. Research, 1912, p. 523.

ings, in a measure, agree with Schridde's idea in so far as they show that the metaplastic cells are newly formed cells and that they come from the growing layer. They seem to contradict the necessity of the presence of embryonic rests, as they could hardly have been so numerous as simultaneously to set up the process in several different bronchi."

Of the 4 cases of primary carcinoma of the lungs examined by me, 2 were upon the right side and 2 upon the left.

One of these cases, No. 2568, an epidermoid carcinoma of the lung, was in a man 50 years old, who had been a very heavy smoker of the strongest tobacco. He had worked in a smelting works where he inhaled very strong fumes of irritating gases. The clinical history of his case was one of tuberculosis, without, however, ever having found tubercle bacilli, which had been sought for some fifteen different times. The points of interest in this case, so far as it concerns this study, are the history of irritation over a long time, presence of a distinctly fibrous condition of the lung attacked, and the metaplasia of the tumor cell into a squamous type.

From the fact that this case was diagnosed, as I understand, as tuberculosis of the lungs clinically, as is done in most cases of cancer of this organ, it may prove on more careful pathological study after death that primary cancer of the lungs is not so rare a disease as is now thought to be. We know already that some cases of cancer of the lungs are mistaken for sarcoma of that organ.

Fig. 1. A non-malignant plaque occurring on the mucous membrane of cheek opposite a jagged tooth. Note the thickening of the epithelium.

OBSERVATIONS ON LYMPHOCYTIC INFILTRATION

Different workers ascribe a protective influence to the presence of lymphocytic infiltration. It is believed their tendency is to inhibit the new epithelial invasion. Theilhaber, above quoted, refers to Fischera's experiments on the behavior of cancer development in mice after bleeding them, which it was claimed stimulated the blood-forming organs to an extent that increased the resistance to cancer after inoculation. Theilhaber lays great stress upon doing many things that stimulate the blood-forming organs to prevent the recurrence of cancer after operation, because he feels that poor blood supply to a part is a causative factor of the disease;

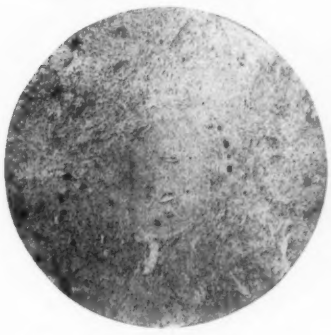


Fig. 2. A thickened artery supplying an epidermoid of the cheek.

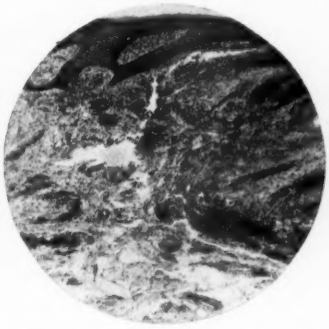


Fig. 3. An early epidermoid carcinoma of the lower lip. Note the rich lymphocytic infiltration.

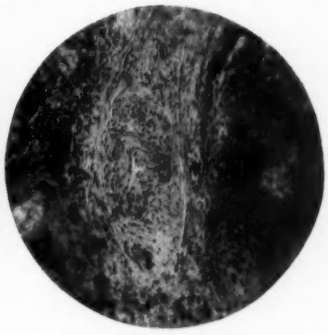


Fig. 4. Thickened artery epidermoid carcinoma cervix uteri. Rich lymphocytic infiltration surround cancer-cells.

Fig. 5. Normal vessels in the cervix uteri from a woman of the cancerous age.

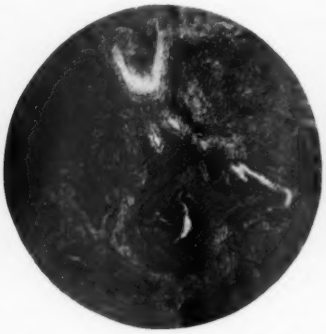


Fig. 6. Adenocarcinoma of the uterus, lumina of vessels patent, rich lymphocytic infiltration.

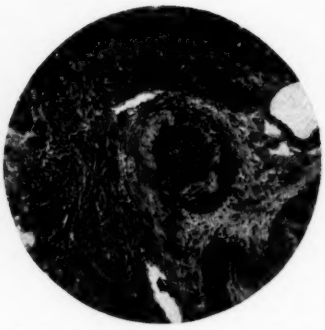


Fig. 7. Thickened artery from the uterus of a woman of the cancerous age.

not alone that, but also that there is a predisposition to cancer which is partly overcome by this increased blood formation and activity produced by bleeding. Bier's hyperæmic treatment, and the injection of certain glands, as the thymus, the spleen, and the uterus, which, he claims, results in producing a leucocytosis that is detrimental to epithelial penetration. This is in keeping with the experiments of Loeb[1] on the development of cancer in mice under varying influences of internal secretions. He says: "It appears probable that with the co-operation of hereditary conditions all those internal secretions are factors in the origin of cancer which initiate or sustain continuous or periodic growth processes. In other cases mechanical stimulation of growth may take the place of chemical stimulation and again in others a combination of both may be present . . . . These two sets of factors are sufficiently strong to determine to a great extent the frequency of cancer in mice."

Bearing upon the importance of lymphocytes as a protective influence against the development of sarcoma in rats, which coincides with similar conclusions reached upon lymphocytes in cancer by Fischera, quoted above, Murphy[2] has conducted some interesting experiments on the heteroplastic tissue grafting on rats from a mouse sarcoma. He found that in 10 rats, which had been subjected to the influence of X-rays for a certain time sufficient to destroy the lymphatic leucocytes, the tumor grew. On the contrary, when the grafting of the same sarcoma was undertaken on 10 normal rats, no permanent growth took place.

Dr. James B. Murphy and John J. Norton,[3] of the Rockefeller Institute, made some very interesting experiments on spontaneous mouse tumors. He removed these tumors from 52 mice. He then placed these tumors aside for the moment and subjected the animals operated on to a regulated dosage of X-ray treatment that was known to stimulate growth of the lymphocytes. Then the tumors were replaced in the animals in another position. The result was that 50 per cent of the tumors grew slowly and 50 per cent failed. There were 21 per cent of recurrences in the old sites of the tumor.

The next experiment was on two control series of mice likewise affected.

First control: Twenty-nine tumors were removed from as many mice and returned into the same animals, only in another region, without any treatment of the animal or the tumor; 96 per cent of the tumors grew and 48 per cent recurred in the old site.

Second control: Ten spontaneous tumors were removed from mice and the tumors subjected to a similar dosage of X-rays as the original experiment. The tumors were then returned into the groin of the animals. The result was 100 per cent of growths and 40 per cent recurrences in the old site.

[1] Leo Loeb. Science, n. s. xlii, No. 1085, p. 914.

[2] James B. Murphy, M.D. Rockefeller Institute Reports, lxii, p. 1459.

[3] Science, n.s. xlii, 842.

Fig. 8. A thickened artery from a carcinoma of the prostate gland.

Fig. 9. Ulcerated gastric carcinoma. Note the cancer-cells infiltrating the floor of the ulcer.

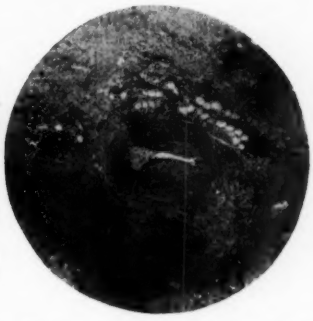


Fig. 10. Thickened artery supplying the ulcerated carcinoma shown in Fig. 7.

SUMMARY

1. I have not found the various old age conditions of endarteritis, acellular connective tissue, or fibrosis, to have been present in all cases of cancer examined.

2. In the study of the various abnormal conditions present in my control series of non-malignant uteri, sclerosed vessels were found without carcinoma.

3. Many uteri, with normal vessels, showed the presence of cancer-cell infiltration.

4. Many cancerous uteri had only normal connective tissue, consequently without fibrosis.

5. Inasmuch as so many of the non-cancerous uteri showed the so-called old age conditions, one would expect to find cancer in them more frequently, if they are a positive factor in the development of cancer.

6. The same may be said of the ovary, where it is quite common to find sclerotic changes in the vessels and fibrosis in the stroma in the cancer without the patient having developed cancer.

7. Certain precancerous conditions do not necessarily develop into cancer. This is notably true in smokers' burns, some of which heal, though simulating cancer. The epithelium in these cases simply piles up without infiltrating the tissue beneath.

8. Lymphocytic infiltration even when present, varied greatly in amount. This was true not alone of the cancers but also of the various tissues used as controls; in some cases being very pronounced, in others quite slight in amount. It was especially marked in the rapidly growing carcinomata.

CONCLUSIONS

1. Of the 206 cases of carcinoma of all organs and regions examined, 105 showed arterial obstructive changes. This gives us substantially an equal division between endarteritis, 50.96 per cent, and normal vessels.

2. Fibrotic changes were present in 118 cases, 57 per cent.

3. Lymphocytic infiltration was present in 85 cases, 57 per cent.

4. That endarteritis and the anatomical changes of old age cannot be looked upon as a constant factor in the production of cancer is shown by the fact that normal vessels were present in almost half the cases.

5. The same holds true of fibrosis or even acellular connective tissue without fibrosis.

6. Lymphocytic infiltration, while present in less than half of the cases, plays a role that is protective rather than etiological.

7. That certain biochemical factors of a local or internal and general type are probably responsible for some cases of cancer.

This study was made in the Pathological Laboratory of the Medical Department of the Ohio State University, through the courtesy of Dr. Ernest Scott, Professor of Pathology. Dr. Jonathan Forman, Instructor of Pathology, was my constant associate in carrying on this study. Mr. Carl Hugger, Assistant in the Department, made the photomicrographs. To all of these I am deeply grateful.

RUPTURE OF THE GALL-BLADDER

Its Cause, Prevention, and Treatment

By W. W. GRANT, M.D., Denver, Colorado

WELL authenticated cases of rupture of the gall-bladder from pathological conditions are few and deserve always the consideration of surgeons and internists.

Traumatism to the abdominal wall may well excite rupture of a distended, diseased gall-bladder, just as a similar blow to the lower quadrant might well aggravate a diseased condition of the appendix or a cystic growth, promoting or causing perforation.

The usual condition predisposing to and causing perforation is an infection of the bladder, usually of long standing. The acute phlegmonous condition is in itself not primary, but secondary to a mild, but steadily progressive, pathological condition from micro-organisms, usually the colon and typhoid bacilli and streptococci, finally resulting in gangrene.

The progress and course is similar to that of the appendix, but not so rapid. Gall-stones will generally be found in these aggravated cases which result in gangrene and empyema.

These conditions are the result of ignorance, neglect, and delay. The internist may not have appreciated the importance and significance of a clinical history, consequently the surgeon has not had an early opportunity to relieve the condition by operation.

Prevention of infection must depend primarily upon healthy dietetic and living conditions and adequate elimination of intestinal toxins. Typhoid fever predisposes to gall-bladder as it does to appendicial infection.

Prevention of perforation or rupture must depend upon early operation. If this had been the rule in the past fifteen or twenty years, we would hear less now of cholecystectomy, which is fast becoming a fad.

Every novitiate, and many who are not, seems to feel that he is not up-to-date unless in the swim of the latest surgical innovations. These innovations, in the realm of the unknown but safely experimental fields, appeal strongly, not alone to the progressive surgeon, but more to that class of surgeons and physicians who pay in cash for business and are not much concerned about the pathological conditions.

Past experience should inculcate lessons of value and of wisdom, as in the popular and much abused operation of gastro-enterostomy for real and doubtful ulcers of the stomach and duodenum, and quite regardless of the important question of pyloric stenosis — the one condition demanding operation that admits of no debate.

I may be pardoned for introducing reports of two cases which are worthy of comment, if not also of record.

Case 1. J. C. M., aged 51, farmer by occupation, was operated on in 1903, for gall-stones — several being removed. The gall-bladder was drained and the wound or fistulous tract discharged bile for nearly a year before completely healing. The patient remained quite well until the spring of 1914, when stomach dyspepsia recurred. This gradually increased until the night of October 10, 1914, when acute symptoms of perforation attended with severe pain, chill, and fever were suddenly manifested. I saw the patient next morning and operated immediately. It was disclosed that in the former operation, the fundus of the bladder was stitched to the abdominal peritoneum, which was a common procedure at that time, but now justly abandoned.

There was a rupture in the fundus and extravasation of a small quantity of pus, but limited by omental adhesions. There was no general peritonitis. A smooth round stone as large as a large pecan nut was removed and probably, as a small stone, was overlooked in the previous operation. It was lodged in a dilated cystic duct and without difficulty removed through the bladder.

The bladder except a small part at the seat of perforation was not gangrenous. This was resected with a small piece of omentum and the bladder pouched and drained. The wound healed perfectly in one month and the patient has been perfectly well since. He had no jaundice. The unsatisfactory progress after the previous operation was doubtless due to the presence of the stone removed in the second operation.

Fig. 1. Gall-bladder showing stone in the fundus and point of rupture.

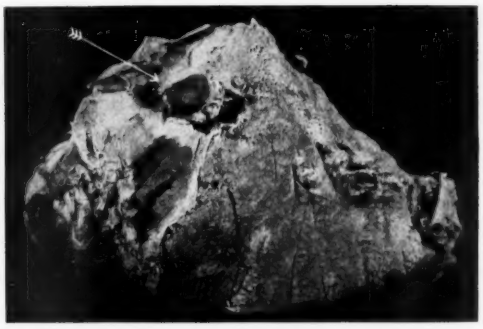


Fig. 2. Reverse side or interior view of liver showing stone.

It might be asked why the gall-bladder was not removed in such a case. I would answer that in the absence of thickened, rigid, gangrenous walls, there is no necessity for its removal, but some good reasons why it should not be. Even skillful surgeons overlook the presence of small stones in the bile-tracts. What happens in such cases when the bladder is removed? The stone is too large to pass the ampulla or papilla. A second operation sooner or later becomes a necessity. Every surgeon recognizes the increased difficulties, if not danger also, of secondary operation on the ducts due to adhesions and the destruction of natural guides and landmarks. It is furthermore easier and safer to drain the gall-bladder than it is the ducts. There is another objection to cholecystectomy. Interstitial pancreatitis is believed to be due to infection from the bile passages; and the most effective treatment of such cases is drainage through the gall-bladder. If the gall-bladder is removed, the matter is needlessly complicated and the treatment more doubtful and difficult.

Is not the presence of the gall-bladder as a receptacle and temporary reservoir for the bile worthy of consideration as serving some useful purpose?

If the infection is easily remediable by a less radical procedure, then it seems to me that cholecystostomy should be the operation of choice. It should be remembered that cholecystectomy does not remove the constitutional diathesis and intestinal toxæmias which exist in infections and gall-stone disease.

CASE 2. Mrs. M., widow, aged 72. Living in comfortable circumstances. Has had occasional attacks of gall-stone colic for several years, which had increased in frequency and severity during the year 1915. On the fourth day of last January she consulted me as to her condition. I urgently advised immediate operation as the character and acuteness of the attacks of colic with local manifestations of disease indicated impending danger from perforation and sepsis. She positively and abruptly declined consideration of an operation. On January 11, she sent for me at night; she had been suffering severely all day and evening from a violent and persistent attack of colic. She was vomiting frequently. The abdomen was generally distended and the walls rigid. Notwithstanding my decided opinion that she was suffering from general septic peritonitis, due to perforation of the gall-bladder, she refused to go to the hospital or to submit to operation. In three days she died from septic peritonitis and paralytic ileus.

I made a post-mortem which revealed some omental adhesions and a pint of extravasated bile in the right kidney fossa. There was no pus in it and none in the small gall-bladder which was contracted around a single round stone the size of a large olive.

I removed with the gall-bladder a portion of the attached liver tissue.

Examination showed a small gangrenous area, half an inch long and one-fourth inch wide with a perforation of the diameter of a slate pencil (indicated by arrow in the photographic picture, Fig. 1). On the reverse side of the specimen (Fig. 2) in the substance of the liver will be seen a light colored and firm stone the size of a small pecan-nut. This might not have caused trouble, and would not have been discovered or suspected in an operation. It was probably in a branch of the hepatic duct.

This patient's life was a needless sacrifice in refusing operation before the last attack, and declining the only chance in the beginning of the fatal illness.

There could be no doubt as to the diagnosis and the necessity for operation. The very limited gangrene of the gall-bladder was doubtless due to the pressure and irritation of the stone, finally resulting in ulceration and rupture.

Gall-bladder infections are common and for a long and indefinite period do not usually give rise to serious illness even in the presence of gall-stones.

More consideration should be given to the early clinical history and to the conditions which predispose to infection.

The condition is curable only by operation and, with early diagnosis and prompt cholecystostomy, gangrene will not be seen often. The mortality will be exceedingly small without the use or necessity of cholecystectomy.

PUERPERAL GANGRENE OF THE EXTREMITIES[1]

By ARTHUR STEIN, M.D., F.A.C.S., New York
Adjunct Visiting Gynecologist, German Hospital; Adjunct Visiting Obstetrician, Harlem Hospital

PUERPERAL GANGRENE OF THE EXTREMITIES

ONE of the most serious and intractable complications of the puerperium and incidentally of pregnancy consists in puerperal gangrene affecting the lower and sometimes the upper extremities. The importance of this menace to childbearing women is plainly illustrated by the reports of 76 authentic cases in the literature, including 5 cases of gangrene after gynecological operations. The disease is, however, fortunately far from common. The occurrence of two instructive cases in his personal experience led the author to make a careful study of peripheral gangrene and the literature on the subject.

In view of the gravity and gloomy prognosis of the condition it seems advisable to bring the entire subject from pathogenesis to therapy to the attention of the medical profession in general and of gynecologists and obstetricians in particular. The prompt recognition of incipient gangrene is the only safeguard against a fatal issue or at best a marked mutilation of the extremities.

The author's first patient, a young woman of twenty years with gangrene of the right leg following abortion, recovered after amputation below the knee. The second patient died of exhaustion with dry gangrene of both feet and lower legs after labor at term.

Case 1. Abortion, curettage; gangrene of right leg, amputation; recovery.

R. R., 20 years of age was admitted to the Harlem Hospital New York on June 9, 1915. The patient was in the best of health and appeared to be an exceedingly normal and strapping young woman. The heart and lungs were normal, the menstrual history normal, the urine normal. Temperature on admission was 104° and pulse 100.

Vaginal examination. Some slight bleeding from vagina; cervix admits one finger; uterus about three months pregnant; adnexa and parametria perfectly normal. *Diagnosis.* Threatened abortion (infection?).

Shortly after admission she aborted a three months fœtus. There was a foul odor from the fœtus as well as from the vagina. The temperature on the next day dropped to normal only to rise again on the same evening to 104° and 105°. The patient continued having a temperature between 104° and 105° for the next six days with no pains, however, and no other symptoms. On the seventh day, after an examination by me, it was decided to curette the patient as the uterus was still enlarged and soft. There were numerous grayish white superficial ulcers around the cervix. These ulcers were covered with a number of whitish membranes. After the curettage by which some placental tissue was removed the whole interior of the uterus as well as the cervix was swabbed with tincture of iodine. This was repeated for the next seven days. Even after the curettage the temperature did not drop entirely but kept between 101° and 102°. On June 23, i.e., 7 days after the curettage, the patient began to complain of pains in her right leg and three days later, that is on June 26, in all ten days after the curettage, the right leg and foot began to swell, became cold, and showed violent bluish discolora-

[1] Read in part at the February meeting of the New York County Medical Society.

Fig. 1. Gangrene of right leg following abortion. Author's first case.

tion. The pulsation of the dorsalis pedis artery was not to be felt and the foot was extremely painful to the touch.

On June 28 there was sensation on deep pressure but the foot remained anæsthetic to light pressure. It was painful on pressure at the line of demarcation. The foot was cold and cyanotic (Fig. 1). There was no pulsation in the dorsalis pedis artery although that in the femoral and popliteal arteries could be felt.

It could now be easily seen that the whole foot was gangrenous. It was highly swollen, of black color, and of a doughy consistency, with pains of an excruciating character. The swelling extended about two and a half or three inches above the ankle. A distinct and irregular line of demarcation could be seen at that point. Numerous small and larger vesicles were seen covering the diseased area.

The whole process became more pronounced and the line of demarcation more distinct so that on July 29, in spite of all conservative treatment, amputation had to be performed below the knee. The patient being otherwise in perfect condition the recovery was uneventful and she left the hospital in due time. The heart had always been normal and several blood cultures showed no growth, especially no hæmolytic streptococci were found.

The Wassermann test was negative.

The result of the histological examination was as follows: "The specimen consists of the lower two-thirds of the leg and the foot. There is an ulcerated area at the external malleolus which exposes the peronei tendons and extends over the dorsum of the foot. Section of the foot shows that the skin and superficial fascia in the plantar region are entirely necrotic. On the dorsum the skin, fascia, and extensor tendons all show marked necrosis. The deep muscles including the tibialis posticus, the peronei and the flexor longus hallucis in the posterior part of the lower third of the leg all show extensive necrosis. No thrombus was observed in either the anterior tibial or the dorsalis artery of the foot. The posterior tibial artery was traced to the external and internal plantar and it was observed that it was patent. The peroneal artery was normal in its relations and structure up to the junction of the middle and lower third of the leg. At this point it terminated in necrotic muscle. At its termination there is a thrombus of blood-clot which gives it a club-shaped appearance. There were thrombi in all the veins especially the venæ saphena magna and parva. Diagnosis: Thrombosis of the peroneal artery, venous thrombosis, necrosis of the skin and superficial fascia, necrosis of the muscle, periostitis of the fibula."

This case is of interest because so far as I could find in looking over the literature, it is only the fourth case on record of gangrene following abortion. Andérodias has published one case of a right leg becoming gangrenous after an abortion in the sixth month and ending fatally. The second case published by Bégouin and Andérodias, occurred in a young woman in whom both legs became gangrenous and the right leg had to be amputated. Here also death occurred. In the case reported by them all findings showed that there was a vegetative endocarditis

Fig. 2. H. Lilienthal's case. Post-operative gangrene of fingers.

present. In Oke's (Simpson's) case the left hand was affected.

CASE 2. Labor at full term, forceps delivery, sloughing of perineal sutures, dry gangrene of both feet and lower legs; no operation; death; no autopsy.

L. F., 19 years old, I-para, was admitted to the Harlem Hospital, New York, on June 12. 1915, at full term of her pregnancy, in generally good condition. Her family and medical history irrelevant. Heart, normal; lungs, normal; other internal organs, normal; urine at time of admission, normal; no œdema present. Wassermann negative.

On day of admission the patient was delivered with medium forceps. A second degree laceration was repaired with chromic catgut sutures. Two days after confinement the patient had a temperature of 104½° and a slight chill. On examination it was noticed that there were some slight ulcers around the cervix for which the patient received the ordinary treatment, iodine applications and douches. The urine now showed traces of albumin and some hyaline casts. The temperature dropped to 101° and 102°. On the sixth day after confinement the sutures were removed because the whole area was sloughing.

Ten days after confinement the patient still had irregular temperatures running up to 103° and 104° and even on the eleventh day a temperature up to 105°. She looked like a very sick person although nothing could be detected outside of the local affection or infection, the heart particularly seeming to be in good condition. Twelve days after confinement on June 27 the patient left the hospital against our advice only to return on July 3, that is seven days later, in an acute and critical condition.

On her readmission (July 3) the heart-sounds were of good quality, heart not enlarged, but its action rapid, rate 110. The temperature varied between 102° and 104°. The abdomen was held rigid. No distinct masses could be felt.

An examination revealed that both feet, symmetrically, for a distance of about four inches above the ankles, were discolored, nearly black, and the skin shrivelled. Both feet were extremely tender on touch, cold, and in some places showed vesicles filled with a whitish fluid. A diagnosis of typical symmetrical dry gangrene of both feet could easily be made. At about four inches above the ankles on both sides the line of demarcation was well pronounced on July 7, but the patient's general condition did not permit of any operative interference. There was no pulsation of the femoral arteries. She finally died on July 19, due to extreme exhaustion and debility. Several blood-cultures showed that there was no general sepsis. It was impossible in this case for us to get an autopsy so we can only guess at the real cause of this symmetrical gangrene.

In both of these cases we have had to deal with a puerperal infection, in the first case of a rather slight nature and in the second much more severe. In the latter case I would like to advance the following explanation of the occurrence of the symmetrical gangrene. A thrombus left the uterus and migrated into the uterine artery and from there into the internal iliac and common iliac artery up to the bifurcation of the aorta where it also occluded the other common iliac artery and by doing so caused the symmetrical gangrene on both sides. This was not the case in our first patient. As can be seen from the description, the onset of the gangrene was rather slow and the gangrene itself of the moist type. This immediately suggests an occlusion of the venous system in the affected limb with the arterial supply still working. I am inclined to believe that the complete venous obstruction was the primary incident

and that the peroneal artery became obstructed only secondarily. It would be wrong to assume that the obstruction of such a small vessel as the peroneal artery could be the only cause of the gangrene of the entire foot and lower leg. I therefore think that for reasons stated above we have to deal in this particular case with an instance of arteriovenous occlusion of the affected area, the venous obstruction being the primary affection.

The following discussion deals with gangrene due to the puerperal state and affecting the extremities. Diabetic gangrene and gangrene due to poisons (secale cornutum for instance) are not included; irrespective of the puerperium, cases of the latter kind were not uncommon in Italy some years ago. Obstruction of non-puerperal vessels, for example in the brain, causing puerperal aphasia as in Sinclair's[1] patient is outside of the scope of the present consideration, but it is noteworthy that the veins in the lower part of the right leg became thrombotic. Another observation which requires separate mention is that of Schulz,[2] who referred the peripheral gangrene of his puerperal patient to post-typhoid anæmia and resulting nutritional disturbances in the central nervous system. There was no evidence of thrombosis. Seidelmann[3] reports a case of symmetrical gangrene of the upper extremities after pneumonia in a woman 29 years of age who about three weeks previously had been delivered of twins. As may be seen from the case histories appended to this article, peripheral gangrene has frequently followed childbirth after even longer intervals in consequence of septic endocarditis and embolism, so that there would seem to be sufficient reason for accepting a puerperal origin.

Raynaud's disease (as is perhaps not generally known) was observed for the first time in a young woman four months after childbirth and since that time (1862) has been reported as occasionally coincident with the puerperium. The disease as described by Raynaud is characterized by the absence of a material appreciable obstacle to the course of the blood whether arterial or venous. According to the description of v. Mehring[4] a prolonged circumscribed vascular spasm leads first to symmetric discoloration and finally to gangrene with shedding of the affected tissue areas, sometimes entire phalanges. There seems to be no reason to doubt that Raynaud's disease may appear as a manifestation of syphilis as well as of other infections. Of special interest from the present viewpoint is the heading of Raynaud's case report, as follows:[5] "Local asphyxia of the feet, hands, nose; dry gangrene of the four extremities going on to the fall of many portions of the ungual phalanges, the whole supervening on a recent parturition. Recovery."

The investigations of Buerger,[6] who studied the vascular lesions leading to presenile spontaneous gangrene, refer to thrombo-angiitis obliterans, the endarteritis obliterans of German writers, a specific disease which must not be confused with the conditions leading to puerperal gangrene of the extremities. There is no reason for assuming that the specific type of infectious organism which he considers responsible for thrombo-angiitis obliterans is identical with the pathogenic agent of puerperal gangrene, a condition in all probability due to a mixed infection. The only similarity consists in the development of certain purulent foci, strongly suggesting the presence of some specific toxin or more probably some microbial agent. Buerger points out that spontaneous gangrene can occur in the presence of patent vessels and of peripheral nerves in which no significant changes can be detected. In all the examined cases of puerperal peripheral gangrene, organic vascular disease was either demonstrable or the impending changes had been arrested by the rapidly fatal termination.

Etiology. Widely scattered among the many millions of births registered in civilized communities, statements are recorded concerning complications on the part of the vascular system in form of puerperal gangrene

[1] Lancet, Lond., 1902, July 26, 204.

[2] Mittl. a. d. med. Abt. d. Herz, Krankenhaus zu Braunschweig; Deutsche Arch. f. klin. med., 1884, xxxv, 186.

Deutsche Ztschr. f. Nervenh., 1904, xxvii, 114.

[4] Lehrbuch der inneren Medizin, 1915, ii, 494.

[5] M. Raynaud. Local Asphyxia and Symmetrical Gangrene of the Extremities. Translated by Dr. Barlow. Selected Monographs, published by Sydenham Society, 1888, p. 75.

[6] J. M. Research, 1915, xxxi, 181, Am. J. M. Sc., 1915, cxlix, 210.

of the extremities. Different types of vascular obstruction in form of arterial, venous, or arteriovenous blocking, with or without changes of the heart-valves, may all culminate in the clinical picture of gangrene. Puerperal thrombosis was found in 76 of 34,951 cases (0.22 per cent) by Klein[1] 25 cases being frankly due to infection alone. Fatal embolism occurred in 4 cases (0.01 per cent). In other words there was one thrombosis in five hundred births and one embolism in nine thousand births. Jaschke[2] mentions one thrombosis in four hundred births and one embolism in nine thousand births. A very important cause of origin of thrombi is a considerable loss of blood whether due to parturition, operations, or other reasons. An abnormal constitution of the blood favoring the onset of thrombosis was described under the name of *thrombophilia* by Mendel.[3]

Peripheral puerperal gangrene of venous origin is very exceptional although diseases of the veins of the genital apparatus in form of varicose and thrombotic veins are of common occurrence during pregnancy as well as in women who have borne a large number of children. Phlegmasia alba dolens, due to obstruction of the iliac veins, with periphlebitis and retrograde lymph stasis is an occasional important complication of the puerperium, but rarely if ever terminates in gangrene.

The arterial origin of peripheral puerperal gangrene is by far the most common and is probably always due to infection. In animal experiments on guinea pigs and rabbits in which extensive thrombi were produced under strictly aseptic conditions, not even the slightest tendency to a rise in temperature could be noted by Nakano.[4] This strongly suggests the probability that the very common rise of temperature in thrombosis after childbirth is always referable to infectious causes. Thrombosis of the arteries of the leg might be due to an ascending thrombosis of the uterine artery: from its terminal branches at the site of the placenta the thrombosis extends into the common iliac and even into the aorta, or it may be continued downward into the external iliac, the femoral artery and its branches. The smaller blood vessels sometimes become obliterated through embolic plugs which have become detached from the thrombi in the large arteries. In favorable cases the onset of gangrene is prevented by the establishment of a compensatory collateral circulation.

The cases in which tissue necrosis does not occur until both vascular systems have become blocked and impermeable constitute the group of arteriovenous puerperal gangrenes. In other cases the blood coagulates secondarily in one system due to complete interruption of the circulation in the other. It is sometimes difficult if not actually impossible to decide if a given case is of mixed arteriovenous origin on account of the difficulty of ascertaining if the thrombi found in one system are of etiological importance or have formed secondarily without contributing to the production of the gangrene.

Although the reason still escapes us why, in certain cases the septic or toxic process becomes localized in the internal wall of an artery and in other cases in the venous wall or in both, the most common cause of puerperal peripheral gangrene is known to be a septic or toxic endarteritis and embolism from diseased heart-valves usually occurring in cases of grave puerperal pyæmia.

Infection, no matter how slight and apparently irrelevant, is invariably present and undoubtedly is always responsible for the conditions leading to gangrene of any kind. Childbirth and the puerperium naturally afford numerous opportunities for infection, a very common and extremely dangerous avenue being represented by thrombi at the site of the placenta in the puerperal uterus. The ubiquitous streptococcus, often in association with anaerobic microbes has been demonstrated as the infectious agent in some of the examined cases. Not only the bacteria themselves, however, but their toxins play an important part, probably through lesions of the vascular endothelium, which in combination with the altered condition of the blood during the puerperium predisposes to the formation of thrombi. In this connection

[1] Arch. f. Gynaek., 1911, xciv, 171.
[2] Zentralbl. f. d. Grenzgeb. d. Med. u. Chir., 1913, xvii, 115.
[3] Muenchen. med. Wchnschr., 1909, xlii, 2149.
Ztschr. f. d. ges. exper. Med., 1914, iii, 541.

the contribution of Eichhorst, on gangrene of the arms and legs after scarlet fever and other infectious diseases, is very instructive. A retarded coagulation of the blood in puerperal women was recently demonstrated by Kottmann.[1] Mechanical factors, the recumbent position and relative immobility of the entire body also enter into consideration as possibly lowering the resistance against infection through retardation of the vital processes. It is suggestive that the majority of these gangrenes concern the lower extremities, although the upper extremities are occasionally involved and in exceptional instances different extremities with other parts of the body may become gangrenous.

According to the fundamental teachings of thrombosis, coagulation of the blood results even in the presence of a sufficient circulation whenever the endothelium of the blood-vessels is damaged in its nutrition and thereby in its physiological function. Besides septic infection other causes, such as a weakened heart action, probably play only the part of the last determining factors. Postoperative thrombo-embolism was directly referred by Fraenkel[2] to septic infection having its entrance avenue at the operation wound, and the same is undoubtedly also true for more distant puerperal thrombi which are likewise referable to a focus of infection. Arterial thrombosis is either the result of a preliminary change of the vascular wall or of a change in the composition of the blood or of a combination of both these factors. Changes of the blood itself usually affect the small and medium sized arteries exclusively, whereas very large vessels may be blocked in consequence of lesions of their walls through microbes or their toxins. The pathogenic agents may lodge in the arterial intima giving rise to obliterative endarteritis, or the germs in the circulating blood may be arrested in the endocardium where they cause an ulcerative endocarditis which in its turn leads to embolism and death of the limb or the patient herself.

The extremely variable cause of the obstruction in the arterial and venous system is best illustrated by the following tabulation, adapted from Wormser:

OBLITERATION IN THE ARTERIAL SYSTEM

1. *Embolism.* In septic endocarditis, with deposits on the heart-valves. Thrombosis of the left heart, chiefly the auricle, the result of septic endocarditis; paradox embolism in case of a patent foramen ovale, naturally rare in a woman who has reached the childbearing age. (See cases of Wanner, Oliver, Popow).

2. *Arteritis.* Primary (septic and toxic endarteritis); secondary (through propagation of inflammation by contiguity from the adjacent veins).

3. *Thrombosis.* Primary (ascending from the uterine artery or its terminal branches at the site of the placenta); secondary (in total interruption of the venous blood current; author's first case).

OBLITERATION IN THE VENOUS SYSTEM

1. *Phlebitis.* Primary (septic and toxic thrombophlebitis); secondary (a) through propagation, in metrophlebitis, (*b*) through extension of the inflammation by contiguity from the adjacent artery.

2. *Thrombosis.* Primary (beginning in infected veins); secondary (interruption of the circulation in the concomitant artery).

Symptoms. The phenomena of incipient gangrene are identical with those of mechanical obstruction of the blood vessels and naturally vary according to the mode of origin and the path of the infection in a given case. Pain is very pronounced and never absent in extensive vascular obliterations such as lead to peripheral gangrene. Infection usually being the etiological factor the ordinary symptoms of puerperal fever are apt to precede the signs of tissue necrosis. Septic puerperal endometritis is present in the majority of the cases. In milder cases only a rise in temperature will indicate some slight infection. The mode of onset of the gangrenous symptoms will sometimes, though rarely, suggest the cause and seat of the vascular obstruction. A sudden onset usually points to embolism in the arterial system (dry gangrene), while on the other hand the gangrene may develop very insidiously in the case of a small embolus. The onset of gangrene may be abrupt or gradual also in cases of purely venous obstruction (moist gangrene) so that the rapidity of evolution of the symptoms permits only an uncertain conclusion as to the seat and origin of the obstacle. In a general practical way it may be said that the early appearance of gangrene in the first few days of the puerperium points to an arterial (the most common) origin.

[1] Cited by Zbinden in Ergebn. der Gynaek., 1914, p. 262.

[2] Muenchen. med. Wchnschr., 1908, p. 989.

The *manifestations* of puerperal peripheral gangrene do not require a lengthy description. Aside from the severe pain already referred to, the absence of arterial pulsation below the thrombus or embolus is an important sign characteristic of the cases of arterial blocking. The sensibility is usually distinctly diminished, while the motility may be preserved. A livid discoloration and a relatively diminished temperature of the affected area add to the probability of incipient gangrene. In cases of venous origin the inflamed veins of the pelvis are often distinctly palpable by the rectum or the vagina due to the existing thrombosis and periphlebitic œdema.

The two forms of dry and moist gangrene are apt to be combined in the same case, depending upon the rapidity of complete interruption of the blood current and the presence of external factors which favor mummification. Although the intolerable pain subsides as a rule when the gangrene has become established, the patient's general condition now becomes seriously aggravated through the absorption of necrotic tissue constituents. Before demarcation has occurred death may supervene, under increasing pulse and temperature, especially in cases of arterial obstruction.

Prognosis. The prognosis of puerperal peripheral gangrene is governed in the first place by the timely performance of amputation. Unfortunately amputation is not always practicable on account of the bad general condition, the rapid progress of the gangrene, or because the seat of the obstruction is located high up in the aorta. Puerperal peripheral gangrene has accordingly a very bad prognosis as one-half to two-thirds of the patients die, for we are not able at the present state of our knowledge to prevent such an unfavorable outcome. While the mortality is still deplorably high, it has nevertheless been lessened by one-half since the institution of modern measures of treatment. The arterial, venous, or arteriovenous pathogeneses probably have no marked bearing upon the prognosis or the mortality although it appears that the mixed arteriovenous type of puerperal gangrene is credited with the most favorable figure.

Treatment. The treatment of incipient puerperal peripheral gangrene consists of purely conservative measures applying simply to the prevention of thrombosis and embolism by means of elevation of the extremity, heart stimulants, judicious transfusion, and similar measures. The appearance of the line of demarcation is the signal for surgical interference. Although the dangerous symptoms may apparently subside because the organism endeavors to resist the absorption of decomposition products from the necrotic area it is imperative to remove the gangrenous part as promptly as possible for the safeguarding of the patient's life.

The *prophylaxis* is limited to the ordinary aseptic and antiseptic management of all deliveries, strengthening of the general circulation by heart tonics, improvement of local circulatory conditions through elevation and gentle massage. When thrombi have formed, elevation of the part is the best treatment to prevent their progress. Premature movements favor the onset of embolism and endanger life.

The manifold instructive features of these cases are best brought out by a comparative study of the material in the general literature. The compilation of authentic cases from the literature of the world brings the entire number of observations up to 76, including 63 cases of peripheral gangrene following labor with one personal observation (author's second case), 4 cases after abortion with a personal observation (author's first case), four cases occurring in the late course of pregnancy, and 5 cases after gynecological operations which have been added for reasons of completeness. Twelve years ago in 1904 a list of 80 cases was published by Wormser but this contains a number of observations which are not verifiable or do not properly belong under this heading. In order to correct another statement of Wormser's the author wishes to state that Begg's article was published in the *Lancet* in 1870 and not 1876. Inaccuracies along this line are especially common in the French literature where, for example, a case is persistently credited to Roux instead of to Rouse, an English contributor to the *Lancet* in 1896. Moreover,

Lafond and other French writers cite 4 cases by Simpson and apart from these the observations of Cowan, Bottomley (called "Bossomby") and Reid, which are precisely the cases reported by Simpson.

The following cases, all very old, incompletely reported, and partly inaccessible in the originals, are cited after Wormser.[1]

CASE 1. Unnamed observer in 1754, Rec. période. d'obs. de méd. de chir. de Pharm., Par., vol. i, p. 149, described gangrene of one extremity twelve days after labor; amputation on the same day without noticeable arterial bleeding. The other lower extremity was shortly afterward affected in the same way and the patient died five weeks after confinement. No autopsy.

CASE 2. Latham, Med. Comment., 1790, ii, 163, described a case in a woman between 30 and 40, three fingers of whose left hand gradually became "quite putrid" one week after childbirth and were removed without pain or hæmorrhage. The condition recurred about six days later and at the end of another fortnight the parts below the wrist were removed. Finally the ulna and radius became loose and were cast off, but the patient recovered.

CASE 3. Coetsem, Ann. Soc. de méd. de Gand, 1835. Puerperal gangrene of upper extremities, nose, upper lip, cheeks, also gangrene of the right leg and knee.

CASE 4. Tonnelé, Arch. gén. de méd., 1830, xxii, 472. Case of puerperal gangrene in a primipara of 24, developing eight days after delivery, in different regions of the body, including the anterior portions of the thighs and the heels. Death on tenth day.

CASE 5. P. E. Edouard Raynaud, Thèse de doct., Paris, 1841. Puerperal gangrene of parts of both arms, cheeks, and chin.

The majority of the cases, 53 in number, concern peripheral gangrene of the lower extremities. The left leg or foot alone was affected 16 times, the right leg or foot alone 15 times, both lower extremities 15 times. In 3 of the case reports the affected side is not specified. In one instance (Begg's case) both hands, both feet, the tip of the nose, and portions of the ears were gangrenous. Maurice Raynaud's case fifteen is similar to this. In Rouse's first case both legs, five fingers, and the right ear, were affected. MacFarlane's patient had gangrene of the right leg and right arm, and Lever's patient of the left leg and left arm.

Following abortion, gangrene of the *lower* extremities is represented by only three cases of which one came under the author's personal observation and was followed by recovery. The right leg as in this case was likewise concerned in a case with a fatal outcome reported by Andérodias. In another case (Bégouin and Andérodias) both lower extremities were involved and the right leg was amputated but without saving the patient's life.

Gangrene of the upper extremities, a relatively rare puerperal complication, is noted in 10 cases, five of which concerned both arms, one with involvement of the legs, one the left and one the right arm. In one instance one finger of each hand was affected, in another the fingers of both hands, finally in one case there was symmetrical gangrene of the fingers, toes, and ears. Following abortion there is only one recorded example of gangrene of an *upper* extremity; namely, Oke's case (Simpson) in which the left hand was affected.

The rarity of peripheral gangrene during pregnancy is illustrated by the scanty number of corresponding observations on 4 cases. Three of these cases concerned the right leg, one (which recovered) with simultaneous slight involvement of the left leg. In the fourth case the little finger of the right hand became gangrenous and was amputated. All these cases occurred in the latter part of pregnancy.

Peripheral gangrene as a sequel of gynecological operations has been reported in 5 cases, which for reasons of completeness have also been tabulated. In the youngest patient, a primipara of twenty years with severe puerperal infection requiring abdominal hysterectomy, both legs were affected by symmetrical gangrene and amputation was performed with a successful outcome. The other four patients, elderly women, died, one with gangrene of the left leg, one of the right arm and one with gangrene of one lower extremity, which was amputated without saving the patient's life. The gynecological operations which had been performed were laparotomies for ovarian sarcoma, multiple or unusually large myoma, abdominal hysterectomy, and oophorectomy plus appendectomy (Lilienthal's case).

[1] Wien. klin. Rundschau, 1904, xviii, 73.

The above figures are given approximately rather than accurately for it will be readily understood that some of the cases belong to more than one group while in others no detailed statements are available.

Arterial obstruction through embolism or thrombosis due to endarteritic changes is especially noted as the cause of the gangrene in 29 cases. Disease of the heart (vegetative endocarditis, aortic stenosis, thickened mitral valves, etc. etc.) alone or in combination with arterial obstruction are noted in 13 cases and persistent foramen ovale in 3 cases. Here it must be emphasized, however, that many cases did not come to autopsy and are incompletely reported in this respect, the observer leaving the cause of the gangrene an open question. Obstruction of both arteries and veins was present in 12 cases, Begg's case being doubtful, however. Venous obliteration alone was apparently responsible in 9 cases (Willcox's case being doubtful). In Schaeffer's case no changes at all were found, neither in arteries nor veins. In 3 out of 4 cases of post-operative gangrene it is stated that the arteries were thrombosed.

Very rarely, and as a suggestion rather than an assertion, a patent foramen ovale is mentioned in explanation of a paradox embolism as in Oliver's first case and in Willcox's case. However, Popow directly charges the open foramen ovale with the responsibility for the puerperal gangrene of both arms in his case, which was free from endocarditis. Among the seventy-five tabulated cases, thirty-three patients recovered and forty died. In two instances (Cowan's second case and Dickinson and Hubert's second case) the outcome is not stated. Only 4 among the 33 cases recovered without an operation (Gutbrod's second case, Dickinson and Hubert's first case, Seidelmann and Schulz's cases).

The presence of an infectious disease was noted in several of these cases: The peripheral gangrene in Schulz's patient developed after premature labor at the end of the third week of typhoid fever. In Seidelmann's case the gangrene followed on pneumonia. Oliver's second patient had pneumonia of the right lung. Pleurisy is stated in one of Cowan's cases.

Puerperal fever and obliterative endarteritis preceded the gangrene in Etienne's case six months after childbirth. Severe puerperal infection, necessitating abdominal hysterectomy is noted by Roux de Brignoles and Auriantis. Puerperal ulcerative endocarditis, as a forerunner of gangrene, is mentioned by Barié and du Casel.

General sepsis is mentioned three times and pyæmia once in association with puerperal gangrene of the extremities, and Montault's patient suffered from peritonitis with probably general sepsis. In altogether six cases peripheral gangrene occurred in combination with eclampsia. The occurrence of puerperal mania is specially mentioned in two observations.

From the forensic viewpoint, the sporadic occurrence of puerperal peripheral gangrene is very important in so far as it may strike when least expected in an apparently uncomplicated case, like lightning from a clear sky. Forewarned is forearmed and the large collection of cases from the literature will serve as a helpful precedent. It is also in this regard that the author hopes to have offered a serviceable contribution to surgical gynecology, in supplementing his personal observations with the interesting material which is so widely scattered in the general literature.

Although the co-operation of unfavorable circumstances which lead to peripheral gangrene can hardly be foreseen and prevented, the safety of our puerperal patients will be decidedly enhanced if the possibility of such a formidable complication is kept in mind. That youth, a healthful condition, and a normal labor do not afford protection, is shown plainly enough in the cases embodied in this paper. A thorough knowledge of the predisposing causes and watchful care at the bedside are the only means to check a further extension of the list of peripheral gangrenes due to the puerperal state.

A. PUERPERAL GANGRENE OF LOWER EXTREMITIES

BARIÉ and DU CASEL. Étude clinique sur les embolies de l'aorte et recherches expérimentales sur la production des souffles cardiaques. Arch. gén. de méd., 1881, i, 29.

Woman, age 30 years, four and a half months after normal birth of her healthy third child was admitted to the hospital on account of indigestion with loss of con-

sciousness. General condition improved under treatment but six days after admission she complained of severe pain in both wrists and the right elbow which were reddened and slightly swollen. Three days later formication appeared in the lower extremities and by the next day it had progressed to complete paraplegia. In view of the abrupt onset of the puerperal disturbances and the sudden infectious turn of the disease the following diagnosis was rendered.

Ulcerative endocarditis of puerperal origin, embolic transportation of a blood-clot into the abdominal aorta and subsequent paraplegia. The general condition became worse and five days later blackish patches appeared on the dorsal aspect of the toes of the right foot with incipient gangrene of the right heel, the second and fourth toe of the same side. The paraplegia remained stationary and at the end of four more days the patient died. Autopsy showed obliteration of the aorta at the bifurcation by a clot which extended into both iliac arteries especially the right. No coagula were found in the arteries of the limbs. (The inferior vena cava was considerably distended.) Notwithstanding the relatively long time which had elapsed since childbirth the authors consider the case of puerperal etiology and due to puerperal endocarditis.

BEGG, J. R. Idiopathic gangrene of the four extremities, nose and ears. Lancet, Lond., 1870, September 17, 396.

The patient was a woman 21 years of age. The gangrene appeared first about 6 weeks after the birth of a healthy child. Double amputation of both hands and feet was performed within 22 days. The cause of the disease was organic changes in the capillaries. The patient made a good recovery. The author contributes an illustration, representing the condition of the amputated stumps. Four artificial extremities were made for the patient's use and proved extremely satisfactory. Patient's heart, normal; no arterial or venous obstruction found. Gangrene of upper extremities of the dry type and that of lower extremities of the moist type.

This case resembles very much Raynaud's Case 15.

BENNET, RISDON. Prov. M. & S. J., 1854, p. 143; cited by Simpson, Obst. Mem. & Contrib., 1856, p. 57.

Patient 33 years old. Difficult labor. Poor heart action, puffiness of the ankles, and pain and tenderness generally in the lower extremities. Three days after admission to the hospital the left leg appeared much as if affected by phlegmasia alba dolens. It was painful, paler than natural and the foot was cold. A day or two after this the opposite limb exhibited similar symptoms. Eight days later both limbs were gangrenous. No pulsation could be felt over the femoral arteries even under Poupart's ligament. A few days later the patient died.

At the autopsy vegetations were found on the mitral valve, a thinning of the walls of the left ventricle existed and a notable bulging of the cavity like a commencing "diffuse true aneurism." From the superior mesenteric artery downward, the aorta was filled with a clot in different stages of change. The iliac arteries, common, external, and in part the internal iliac were blocked as was also the femoral for two inches below the groin.

BERGEN, LLOYD. General erysipelas occurring during puerperium, followed by popliteal thrombosis and gangrene. Med. News, 1895, p. 424.

Woman 34 years old, III-para. On the eighth day after third confinement erysipelas began on the face. Finally discoloration and high sensibility to touch set in on right foot. No pulsation of the tibial arteries. Amputation below the knee. Findings: obstruction of femoral artery, the popliteal artery entirely thrombosed. Recovery.

BLACKMAN. A case of puerperal gangrene with observations. Cincin. Lancet & Obs., 1850, xx, 90.

Patient, 18 years old, had suffered from eclampsia which continued for 48 hours after the birth of her first child. On recovering consciousness she complained of coldness and numbness of both lower extremities; this was soon followed by excruciating pain in the limbs. One week after delivery the left foot and leg became suddenly of a livid color, and on examination, no pulsation could be detected in the femoral artery of either extremity. About seven weeks after delivery, the limb was amputated and the general condition at first improved, but the patient finally died. At the autopsy the abdominal aorta was found completely obstructed by fibrous clots, the obstruction extending from two inches above its bifurcation, throughout the iliac, femoral, popliteal, and tibial arteries of the right extremity and the same vessels to the end of the stump on the left side. The iliac and femoral veins were also filled with firm coagula.

BOTTOMLEY. Lancet, Lond., 1845; cited by Simpson, Selected Obst. & Gynec. Works 1871, p. 565.

Patient aged 39. Pregnancy normal until within a month of delivery, when she suffered from cough and great debility. Labor, however, was expeditious; lochia small in quantity and the after-pains slight. The woman continued doing well for ten days, when symptoms of pleuritis with considerable constitutional disturbance presented themselves. Two or three days after her recovery from the pleuritic attack she complained of pain in the heel, passing from thence to the great toe and ankle joint. Pain was treated as neuralgic, but without good results. At length a livid spot appeared on one of the toes, the temperature of the foot and leg gradually diminished, and sensibility was impaired. The toes successively became black, and this appearance extended so as to involve the foot and ankle. The line of demarcation formed about two inches above the ankle-joint, and amputation was performed above the knee. Recovery was complete, and she has since borne two children.

BURCKHARD, G. Gangraen der unteren Extremitaeten im Wochenbette. Zentralbl. f. Gynaek., 1900, li, 1381.

CASE 1. Woman 38 years of age at the end of the seventh pregnancy; had never had a normal labor, on account of rachitic pelvis. Decapitation was required. Incomplete rupture of the uterus. Puerperium: Moderately high fever up to twelfth day, on account of puerperal endometritis. On the twelfth day onset of anæsthesia in the toes of the left foot, gradually progressing upward; until two weeks later, the entire left foot, the entire calf, and the anterior side of the leg were discolored and painful. Three weeks after childbirth, amputation of the thigh was performed. Examination of the amputated limb showed complete thrombosis of the popliteal vein.

CASE 2. Woman, 33 years of age, V-para. First birth was spontaneous; in all others transverse position of the fœtus, the last time perforation of the after-coming head after version. Rachitic pelvis. Induction of premature labor, on account of the unfortunate outcome of the last four confinements. Extraction of child, which died. Rupture of symphysis. Further course of puerperium: œdema of left lower extremity, followed by cyanotic discoloration and anæsthesia of the foot; finally distinct demarcation in region of malleoli, and moist gangrene of

foot. Amputation of left leg at upper third. Examination of the specimen showed thrombosis of the posterior tibial artery. The thrombus extended upward from the site of the amputation, and could be drawn out from the vessel.

CHOLMOGOROW. Gangraen der Fuesse im Puerperium. Russk. Vratch, St. Petersb., 1908, vii, 1246; Petersb. med. Ztschr., 1909, xxx, 37.

The author observed a case of gangrene of both feet, in the puerperium, terminating in death. The patient was a II-para, eighteen years of age. Manual extraction of placenta. Left thrombophlebitis. Thirty days postpartum gangrene of left foot. Finally death after erysipelas had set in.

COWAN. Cited by Simpson, Selected Gynec. & Obst. Works, 1871, p. 564.

Patient age 36, healthy and active. Delivered of fourth child; lochial and lacteal secretions were natural. On the morning of the fourth day she had a severe rigor, and when seen she was screaming from excruciating pain, referred principally to the upper and inner portion of the left calf, which was cold and tense, but not increased in size. This condition extended to the foot, on the forepart of which a large spot of ecchymosis appeared, most evident upon the metatarsus and creeping upward to the ankle-joint. The uterus was perceptibly larger than usual. The discoloration had reached half way up the calf of the leg (having a wavy margin) and was still advancing. The following morning vesication had begun on the spot first discolored and the patient was rapidly sinking. Death occurred early on the fourth day of the disease and the eighth day after delivery. No autopsy.

COWAN. Cited by Simpson, Selected Obst. & Gynec. Works, 1871, p. 564.

Patient aged 25. Ten days after delivery of her first child she was seized with gangrene of one of the lower limbs. The gangrene involved the foot and leg nearly to the knee-joint; the patient was greatly exhausted and anxious, but not suffering severely. The limb was amputated at the lower third of the thigh, but not a drop of blood followed the knife. She died the next day of exhaustion. No autopsy.

DAVIES, J. A case of phlegmasia dolens which terminated in sphacelus of the leg and foot. Lond. Med. Reposit., 1825, xxiii, 451.

The patient a XI-para, was suddenly seized with a most excruciating pain in the left loin and hip, two weeks after her last confinement. The limb gradually became swollen and very cold; the leg and foot and lower two-thirds of the leg were of a dark purple color, and a distinct line of demarcation formed. In the course of the following week, considerable sloughing took place on the lower and back part of the leg, until scarcely anything remained but the bare bones. The author finally removed the limb above the knee. As soon as the vessels were cut across, the blood in the veins was seen to be coagulated, arteries intact. Patient made a good recovery.

DEROYER. Embolie de la partie inférieure de l'aorte. Gaz. d. hôp., 1880, p. 732.

Primipara, age 22 years, two weeks after a normal confinement, was attacked by severe pains in both legs, and examination showed the absence of pulsation in both femoral arteries. Next day appearance of a large discolored patch on anterior portion of left knee, followed by other patches on the left calf, and a purplish discoloration on the right side. Lower portion of right leg was discolored up to 25 cm. above the malleoli. The condition of the limbs became aggravated in the course of the following days, while the general condition improved, until three weeks after the first onset of the pain, the patient had an attack of delirium, followed by fever, and died three days later. No autopsy could be obtained. Judging from the simultaneous appearance of the disturbances in both limbs at once, the obstacle must have been situated in the aorta near the bifurcation.

DUFLOCQ. Gangrène du pied droit ayant déterminé la mort un mois et demi après l'accouchement. Progrès méd., 1882, p. 1013.

Woman 38 years old, IV-para, toward the end of pregnancy had sudden pain in the right foot with discoloration and insensibility, the foot being absolutely cold. After awhile the foot became black. Two weeks after the onset of these symptoms she was delivered of a dead child. One month after confinement the patient was in a very bad condition, the foot being black and insensible and the tissues soft to touch. On pressure there was a gaseous crepitation. No œdema of the leg. Sugar in the urine not due to a previously existing diabetes. Bloody expectorations. Death seven weeks later. On autopsy, the genital organs were found to be normal. In the right upper lung gangrenous pneumonia. Slight thickening of mitral valve, heart otherwise normal. Right femoral artery obliterated by a thrombus commencing immediately below the bifurcation of the aorta. All the arteries of the right leg also obliterated. The author does not assume an embolus because the heart was practically normal.

DUNCAN, JAMES. Cited by Simpson, Selected Obst. & Gynec. Works, 1871, p. 539.

Patient delivered of first child after a protracted labor. Two weeks afterward acute gangrene of both lower extremities. Death four days after admission to the hospital. On dissection heart was found to be normal. Beginning about an inch and a half above the bifurcation of the aorta a fibrinous plug was found which completely occluded the artery and extended along the common iliac, and as far as one or two inches down the external iliac arteries on each side. A prolongation of the plug shut up also the canal of the internal iliac artery on the left side while on the right side the opening of the internal iliac artery was occluded by the obstructing mass occupying the common iliac artery. The femoral and other arteries below were quite healthy and the veins of the limbs presented no special morbid appearances.

ECCLES. A case of bilateral gangrene of the legs following confinement. Brit. M. J., 1913, p. 1227.

Patient, a woman 38 years old, was admitted to hospital two days after normal delivery of her twelfth child. Ten days after admission, symptoms of incipient gangrene made their appearance, the condition becoming aggravated about a week later, and gangrene simulating more the dry type than otherwise, was manifest. Three days later the limb was amputated through the middle of the thigh; well above the external limits of the spreading gangrene. At the end of five days following the operation, loss of circulation was noticed in the right lower extremity, and gangrene up to the knee became evident. Patient refused to have the limb amputated; her general condition up to the time of death remained remarkably good. Death took place suddenly, about twelve weeks after the first appearance of gangrene. Post-mortem examination showed that the external iliac and the common iliac arteries, as far as the bifurcation of the aorta, were blocked by a continuous thrombosis, evidently of some standing.

ESCALIER. Bull. Soc. anat. de Par., 1846, xxi, 277.

Presentation of specimen from a woman 28 years of age, who had died of spontaneous gangrene following her first confinement. After an attack of peritonitis, pain was felt in the right leg, without signs of phlegmasia alba dolens. Four days later, gangrene manifested itself and at the time of the patient's death, on the fifteenth day after the onset of the disturbances, the gangrene extended above the calf. At the autopsy the hypogastric veins and several of their branches, as well as the right common iliac vein, were found blocked by solid gray thrombi, adherent to the vascular walls. The iliac artery at its junction with the femoral contained a firm, grayish clot which filled the third part of the arterial lumen and became bifurcated at the level of the profunda femoris. The findings were suggestive of a partial arteritis, due to compression of the femoral artery through an abscess of the iliac fossa.

ETIENNE. Gangrène massive d'un membre inférieur par endartérite oblitérante progressive, suite à distance d'une infection puerpérale. Arch. gén. de med., 1904, ii, p. 2402.

Patient, primipara 26 years of age, forceps delivery, infection of wound in vulva, puerperal fever, recovery. Some months after childbirth, onset of double phlebitis of lower limbs, type of phlegmasia alba dolens, requiring three months for its cure. About three months after recovery from this phlebitis, a vesicle filled with reddish fluid appeared in the anterior portion of the middle third of the right leg. This was soon followed by symptoms of incipient gangrene, with discoloration in the left foot. The condition became gradually worse, the patient left the hospital and died about 8 weeks later.

FAISON. Moist gangrene of both legs following parturition. North Car. M. J., 1889, xxv, 401.

Patient primipara, 19 years of age. Symptoms of septic infection five days after childbirth, with chills and fever. Within ten days she complained of cold feet with intolerable burning pain; within fifteen days appearance of characteristic dusky hue of gangrene in both feet. The morbid process continued, reaching in the left leg within three inches of the knee, and in the right leg three inches above the ankle before the patient succumbed to pyæmia, ten weeks after childbirth.

FISHER, TH. Double phlegmasia followed by gangrene of the right foot. Lancet, Lond., 1898, i, 995.

Patient 45 years old, XV-para; manual extraction of placenta on account of hæmorrhage. Deep collapse 4 days after confinement; pains in abdomen and joints, diarrhœa. On the eighth day, phlegmasia. Pulse 120 to 130; temperature 104°. On the twelfth day, bluish discoloration of right leg, and diminished sensibility. General condition of patient very poor but improved under stimulants. The toes became gangrenous and were finally amputated.

The author discusses only the influence of marked hæmorrhage on the formation of the phlegmasia, but he does not enter into any discussion on gangrene.

The case is similar to Wormser's first case.

FUSSEL, M. H. Gangrene of leg following labor. Univ. M. Mag., Phila., 1888, i, 165.

Patient had injured the great toe of left foot; eczema up to knee followed, previous to present pregnancy. In eighth month of pregnancy left thigh twice its normal size, covered with abscesses. Two hours after labor (normal living child) the limb became livid; there was intolerable itching and burning; the foot was cold and the patient went into collapse. No amputation on account of bad general conditions. Death.

The author thinks that the popliteal artery was closed by a thrombus, which began to form a few days previous to labor. "The slowing of the blood in the artery consequent to labor allowed a complete clot to form at the inflamed point and consequently gangrene resulted."

GOLDENFELD, EUGENIE. Ueber Gangraen der Extremitaeten, Inaugural Dissertation, Bern, 1909.

Patient 25 years old, normal delivery; out of bed on the eighth day. On that day violent pains appeared in left foot which after a few days became entirely black and of a penetrating odor. No pulsation in the popliteal artery. The left thigh was swollen but not painful. The entire right leg was highly œdematous and very painful. Amputation of left leg below the knee. Recovery.

Diagnosis: gangrene due to embolus. (No mention of the location of this embolus.)

GUTBROD, O. Gangraen nach Eklampsie. Monatschr. f. Geburtsh. u. Gynaek., 1905, xxi, 734.

CASE 1. Patient, a primipara, age 22 years, had many eclamptic seizures, seventeen in number, and was treated with hot packs. On second day on removing the hot packs, it was seen that extensive gangrene of the skin and subcutaneous tissue had occurred in all the places where two skin surfaces had been in contact. Patient had fallen asleep in such a position that the left hand was under the sacrum, and the left foot crossed over the right, with the result that the following localities had become gangrenous: The entire left hand, the skin over the sacrum, both inner surfaces of the knee-joints, the left heel, and the dorsal side of the right foot. All healed fairly well, except the right foot; on account of the deep abscess which developed about two months' later, destroying the entire ankle-joint, amputation had to be performed below the knee-joint.

CASE 2. A V-para, 47 years of age had eclamptic seizures, before and after spontaneous delivery. Patient got up on tenth day; on the evening of this day, the temperature which had been perfectly normal in the last five days suddenly rose to 105°.

The left big toe presented a bluish-black discoloration of the skin, and the entire foot was bright red almost up to the knee-joint. The gangrene and inflammation progressed during the next day but remained limited to the skin and subcutaneous connective tissue. The process lasted over four months, under a high fever, and terminated in recovery.

HAGEMEYER. Ueber puerperale Gangraen der unteren Extremitaeten. Wien. klin. Rundschau, 1901, xv, 685.

The patient, a V-para, 40 years of age, had myodegeneratio cordis, and secondary relative mitral insufficiency. On ninth day after delivery, symptoms of thrombosis in left leg; followed by dry gangrene of the foot and the adjacent portions of the leg. On seventeenth day after childbirth amputation at the lower third of the thigh. Recovery.

Examination of the amputated extremity showed an obturating, evidently embolic clot, at the bifurcation of the popliteal artery. All the arteries were thrombotic.

V. HOCHSTETTER. Spontane Gangraen beider unteren Extremitaeten nach dem Puerperium. Wien. med. Wchnschr., 1888, p. 74.

Patient, 24 years old, (?) para. During the fifth week pains in right leg which became œdematous. During the seventh week post-partum, the patient was admitted to the hospital. At that time the entire foot was bluish black;

pulse in femoral artery not present. The veins were not dilated. Heart and urine normal. Temperature 102.2°. During next few days demarcation below malleoli. About 2 weeks after onset of disease pains in left leg, which was bluish up to knee and anæsthetic but not œdematous. Demarcation of left leg up to height of the knee. Two months after beginning of disease, amputation, on the right side above the malleolus and on the left in the middle of the thigh. No description of the findings of the amputated legs. Recovery.

The author explains his case as follows: Ascending thrombosis of the right uterine artery and of the hypogastric and external iliac arteries followed by gangrene on the right side; then continuation of the thrombosis up to the bifurcation of the aorta and here at that point either occlusion of the left common iliac artery or embolism followed by gangrene on the left side, and finally extension of the thrombus up to the renal artery, which might explain the existing albuminuria.

LANCEREAUX. Phlébite puerpérale. Gaz. Méd., 1887, No. 8.

Patient 22 years old, III-para, normal delivery; out of bed on fourth day. On fifth day œdema of left leg. Urine and heart normal. Three days later, after the first signs of œdema on the left leg had subsided, œdema appeared of the right leg, of the abdominal wall and also of the left labium majus. The diagnosis was obstruction of the hypogastric vein and vena cava. About a month later coughing, dyspnœa and pneumonia in the left lower lung set in, due evidently to pulmonary embolism. One week later, marked pains in both legs with discoloration. Sensibility diminished and practically gone below the ankle. Diagnosis was obliteration of the two femoral arteries because no pulsation was felt over them. Death. Autopsy: Obliteration of the uterine sinuses. All the veins (hypogastric, external iliac, femoral and renal) obstructed by clots. The aorta, the renal arteries, the common iliac, the hypogastric, the external iliac and the femoral arteries, thrombotic.

The author explains the formation of the thrombosis as follows: It started in the uterine sinuses and was propagated into the renal veins, and thence into the renal arteries either by contact or through the renal capillaries, from the renal arteries the process extended to the aorta and downward.

LANCEREAUX. Cited in Troisier's Thèse d'agregation, 1880.

The patient, a woman 31 years of age, with phlegmasia alba dolens of the right leg, beginning six weeks after confinement and terminating in abscess and gangrene of the calf, died one month after admission to the hospital, about ten weeks after childbirth. The autopsy showed considerable œdema of the lower extremity with cutaneous gangrene of the calf and the lower surface of the right thigh. The femoral veins contained a black clot, becoming less firm and dark in its upper portion. In the iliac veins the clot began to be softened in the center, and it reached into the inferior vena cava, as far as the renal veins. Into the right renal vein it sent a process which entirely obliterated the vessel, and another process extended into the left renal vein, blocking it only at its termination. The hypogastric veins were filled with more or less indurated blood-clots.

LEVER. Cited by Simpson, Selected Obst. & Gynec. Works, 1871, p. 529.

Patient suffered from an attack of acute rheumatism during pregnancy, and died after a few days' illness following delivery. During this period it was discovered, that there was no pulsation in the arteries of the left arm; and subsequently the same absence of pulsation was observed in the left inferior extremity. Local symptoms of gangrene were manifest in the left hand and left foot. At the post-mortem examination, mushroom-like vegetations were discovered on the valves of the heart; and in the arteries of both the affected extremities vegetations were found obstructing the lumen, while the veins contained phleboliths.

LEYZEROWICZ. Ueber die Entstehung von Gangraen der Extremitaeten nach der Geburt. Gaz. lek., 1910, No. 32.

Gangrene of the foot on seventeenth day of septic puerperium after a complicated labor. Author claims the gangene was due to embolism of the dorsalis pedis artery. No autopsy.

Primipara 18 years of age. Diarrhœa for a long time before birth of a dead premature child. Ulcera puerperalia portionis vaginalis septica. Right foot became swollen on the fourteenth day after delivery, gangrene three days later. Patient was now admitted to the hospital, where she died at the end of twenty four hours.

LUGEOL. De la gangrène des extremités chez les accouchées. Gaz. hebd. d. sc. méd. de Bordeaux, 1901, xxii, 112.

The patient, I-para, 22, had albuminuria and suffered from eclamptic attacks during labor; was delivered with forceps, of a dead child. On tenth day phlegmasia alba dolens, on right side; four days later onset of gangrene of right leg, requiring amputation two months later. The operation was followed by recovery. Examination of the amputated extremity showed the presence of clots in the arteries, which presented endarteritic changes caused by streptococci.

MACFARLANE. Cited by Simpson, Selected Obst. & Gynec. Works, 1871, p. 529.

The obstruction of the artery occurred suddenly ten days after the patient was delivered naturally and easily of her fifth child. At that time she began to complain of acute pain and numbness in her right arm, which, with slight intermission from opiates, etc., continued till her death, at the end of three weeks. No pulsation could, from the first or subsequently, be felt below the middle of the brachial artery. A week after this arterial occlusion in the upper extremity, a similar change took place in the right thigh, accompanied with acute pain. This ceased in a great measure four or five days after, when unequivocal indications of gangrene showed themselves, commencing at the toes and extending to the knee. On dissection, the aortic valves were found to be covered with numerous vegetations. The aorta was dilated and studded with atheromatous deposits. At the points of obstruction (viz., the middle of the brachial, and the commencement of the lower third of the femoral arteries) fibrous clots were found, which completely closed these vessels.

MANDL. Ein Fall von Gangraen der beiden unteren Extremitaeten im Wochenbette. Wien. med. Wchnschr., 1901, lx, 1307.

Primipara, 23 years of age, spontaneous labor; fever from second day on, infected perineal wound. Venous thrombosis began on seventh day on the left side, on eleventh day on right side, leading to gangrene on the thirteenth day. Whereas on the left side the gangrene was limited to a few superficial areas, amputation above the knee had to be performed two and one-half months later on the right

side, the operation showing that all the arteries and veins were blocked. Favorable healing of the stump. Recovery.

MOIR. Cited by Simpson, Selected Obst. & Gynec. Works, 1871, p. 525.

Patient, I-para, was prematurely delivered. Three weeks afterward pains like those of neuralgia were experienced, first in the right leg and then in the left. Seven weeks after delivery there was sudden pain and tenderness in the left groin. At this time a loud systolic murmur could be heard. Some days subsequently the pulse in the right arm became suddenly arrested and no pulsation in the right femoral and iliac arteries could be felt. The arterial pulsation in the larger vessels of all the extremities had ceased with the exception of the left arm. Finally gangrene of the great and two next toes of the left foot set in ten weeks after delivery. The patient died a few days afterward.

Autopsy: Thrombi in bifurcation of aorta, common iliac and external iliac arteries, vegetative endocarditis.

MONTAULT. Accouchement naturel, péritonite, engorgement des membres inférieurs avec symptomes de phlegmasia alba dolens; mort. Présence de pus dans les veines des jambes. J. compl. d. sc. méd., 1831, lx, 11.

Patient a woman 23 years of age on day following normal birth of a healthy child, was attacked by peritonitis. Twenty days after the delivery the left thigh became swollen and very tender on pressure. The swelling increased in the course of the next following days and a week later had invaded the right lower extremity under the same symptoms. The gangrenous patches extended into the depth of the tissues and the patient finally succumbed to exhaustion five weeks after delivery. Autopsy showed phlebitis with the presence of pus and of whitish false membranes in the veins of the legs.

OLIVER, TH. Gangrene of the leg in puerperal women with severe pain in, and analgesia of, the affected limb. Lancet, Lond., 1896, ii, 15.

CASE 1. Patient 23 years old, I-para; in good health. Labor and early part of puerperium normal. Two weeks after labor patient became weak, and paresis of the right arm and facial nerves developed. There was a slight aphasia. The right leg was intact. On the following day the paresis had disappeared, whereas marked pains in right leg set in. The same evening the small toe of the right foot became gangrenous. The lower two-thirds of the leg showed a darkish blue discoloration. The next morning the temperature was 98.8°, pulse 104. The foot was nearly bluish black; the leg showed livid discoloration and was cold and anæsthetic up to about 2 inches above the knee. Passive motion of the leg and pressure on the big arteries and veins was extremely painful. No albumin in urine; heart normal. The gangrene progressed rapidly, without a marked demarcation. Two days later amputation was performed about 5 inches above the knee. Recovery. The popliteal artery and vein of the amputated limb were thrombotic. (Whether the thrombi were tightly adherent to the walls of the vessels is not stated.)

CASE 2. Patient 25 years old, II-para, normal labor. About four days later pneumonia of right lung; six days later, quite suddenly marked pains appeared in right leg, the leg showing no abnormal condition. Examination showed a marked systolic murmur of mitral valve. The whole left lung was infiltrated. Nothing was felt in the abdomen. The right leg was pale, cold, swollen, anæsthetic. The skin was purplish blue. Over the aorta, there was a slight systolic murmur. The foot and leg up to about 2 inches below the knee were entirely anæsthetic and cool. As apparently the gangrene spread rapidly, amputation above the knee was performed. Five days after operation patient was decidedly better but she died three weeks after operation. No autopsy.

Examination of amputated leg showed embolism of popliteal artery extending into its two branches; all the veins contained coagulated blood (thrombi?).

This second case is remarkable because the endocarditis developed, so to say, under the physician's eyes (similar to Wormser's first case). The thrombosis of the veins is also of a secondary nature. It is clearly a case of general sepsis, similar to Winckel's case.

In Oliver's first case it is also remarkable that the gangrene developed so quickly that in 4 days after the onset of the first pains amputation of the thigh had to be done. On the fourteenth day after confinement general debility and paresis set in, due in Oliver's opinion, to embolism of one of the arteries of the brain, whereas the obliteration of the popliteal artery was "consequent upon the action of a poison causing clotting of the blood."

The heart was normal. If that was the case there is only one explanation of this case, similar to Wanner's case, and that is that there was an open foramen ovale; i.e., an embolism from the side of placental insertion. The embolus is not thrown from the right auricle into the right ventricle and from there into the pulmonalis, but finds its way through the open foramen ovale into the left heart and divides itself there into different parts. Small particles were thrown into the left carotid and gave rise to the embolus in one of the arteries of the brain, whereas the bigger part of the embolus is thrown into the cruralis where it forms a total occlusion of that artery. The clots in the veins are apparently of secondary nature as there is in the clinical picture no signs of any phlebitis.

It is hard to give a satisfactory explanation for the extremely quick progress of the gangrene.

OVERHISER. A case of phlegmasia dolens, terminating in gangrene of the foot. Amputation, Recovery. Med. & Surg. Reporter, 1875, xxxiii, 127.

The patient, a woman 34 years of age, developed gangrene of her left limb, about three weeks after the birth of her eighth child. Severe pain in the limb which was swollen and tender, especially along the course of the femoral vessels, was felt first on the ninth day after con-

finement, and a fortnight later, evidence of gangrene was seen on the inner side of the heel, rapidly spreading and invading the entire foot. Amputation was performed at the lower third, the swelling disappearing rapidly, and the patient less than two months later was discharged with a good stump, and health completely restored. At the time of the operation the large arteries were found completely obstructed.

PHILLIPS, R. Gangrene of the legs during the puerperium. Death. Middlesex Hosp. J., Lond., 1904, viii, p. 70.

Apparently normal puerperium for seven days after birth of patient's third child. Well nourished woman of 29. One week after childbirth, alarming attack of sudden severe pains shooting down the left leg, with general collapse. Signs of femoral embolism were found on examination. Condition of the leg did not improve, and four days later the toes began to become discolored. Eight days after the first attack patient had a similar attack in the right leg. Her condition from now on got worse, the feet and legs gradually passing into a state of dry gangrene. Gradually the gangrene extended half way up the left thigh and above the right knee, in its upper part being moist and offensive. Patient gradually weakened and finally died, fifty nine days after labor. She was never in a condition to permit operation. The uterus and heart were normal.

REID, ROBERT. Cited by Simpson, Selected Obst. & Gynec. Works, 1871, p. 564.

Patient had previously borne a large family. Last labor was easy, for it came prematurely; child born dead. On the third or fourth day subsequent to delivery fever supervened, followed by swelling of the left leg, which was attended by great pain and suffering. In the course of two or three days gangrene set in and she died ten days after delivery. No autopsy.

ROUSE, E. R. Gangrene complicating puerperal mania. Lancet, Lond., 1896, ii, 1375.

CASE 1. Patient 31 years old, I-para. Two weeks after normal confinement admitted to London County Asylum on account of mania. Physical condition good. Eight days after admission to the asylum pains in feet and fingers which were cold, anæmic and anæsthetic. The next morning all the toes and the five fingers of one hand and the right ear were gangrenous (Raynaud's disease). No fever. The lochia which were suppressed for awhile became very offensive. The gangrene of the feet progressed slowly. Temperature up to 102°. On account of impending heart failure, amputation of both feet, on the right side at the lower third of the leg and on the left side after Syms method. On the thirty-first day after amputation temperature 102°, on both stumps new gangrenous spots which were cauterized. Recovery. Left the asylum after eight months in a mentally normal condition.

CASE 2. Patient 37 years old, V-para. Confinement three months previously. Admitted for very pronounced maniacal condition. Two weeks after admission, there set in a very rapidly progressing gangrene of the right foot and leg. Amputation after two weeks from onset of symptoms in lower third of the thigh. Examination of the amputated limb showed a very extensive thrombosis of the veins and endarteritis of the larger arteries.

It is a question whether this second case can still be classified as a case of "puerperal" gangrene, since the symptoms set in three months after confinement, but the possibility of a connection cannot be denied. The case also is of interest because it was shown microscopically that both the arteries and the veins were diseased.

SCHAEFFER. Ueber Unterschenkelgangraen im primaer afebrilen Wochenbette. Muenchen. med. Wchnschr., 1903, xlv, 1963.

Patient, primipara suffering from gonorrhœal infection. Puerperium was afebrile but with constant slight elevation of the pulse rate. After moderate femoral œdema and symptoms of crural phlebitis, without obturating thrombosis of the principal veins, rapidly progressive œdema made its appearance in the left foot, followed by extremely severe congestion. Onset of gangrene three days later, associated with establishment of severe congestive hyperæmia of the left foot, with inflammation of the right saphenous vein.

Amputation of the left foot. Examination of amputated portion showed cutaneous gangrene as far as Lisfranc's articulation, with circumscribed excoriations of the malleoli. The muscular gangrene concerned the extensors and the inner calf muscles. The arteries and veins were entirely free from thrombi or emboli. The congestion of the right foot subsided after the amputation of the left leg. Recovery.

SCHUHL. Gangrène d'un membre inférieur pendant les suites de couches. Prov. méd. 1906, xviii, 205.

Gangrene of the left leg in a previously healthy VII-para of 38 years. Three eclamptic seizures before childbirth, which was normal, and three seizures after delivery. Rapid recovery. Delirium and hallucinations on the fourth day. Two days later patient suddenly complained of severe pains in both legs, especially the left; at the end of three hours this leg was cold, livid, anæsthetic up to four fingers' width above the knee. No pulsation was palpable in Scarpa's triangle. On the eighth day after delivery the left leg was purplish in color and presented a large blister on the external malleolus; on the twelfth day a large blister appeared on the posterior surface of the thigh. The condition gradually became worse, the pains extending to the entire abdomen, and the patient died 18 days after confinement. No autopsy could be obtained, but the bacteriological examination of the thrombotic blood in the left femoral artery showed the presence of streptococci and staphylococci.

TATE, MAGNUS A. Puerperal gangrene. Am. J. Obst., N. Y., 1898, xxxvii.

Seven and one half months pregnancy, eclamptic. One day after confinement, patient had sleepy feeling in left foot, afterward both legs became gangrenous. Death 23 days after confinement.

VAN GIESON. Puerperal thrombus, endocarditis, dry gangrene. Tr. N. Y. Path. Soc., Med. Rec., 1883, Sept, i, 246.

Patient 32 years of age, who, twenty days after childbirth, was attacked with severe burning pain in the right foot and leg. Discoloration of the skin, extending a few days later to the ankle, with complete blackening of the skin over the lesser toes. The patient lingered in great pain for five weeks and then died. The right femoral vein contained a clot completely filling the vessel and partially organized. The right femoral artery contained a firm laminated thrombus.

WANNER, R. Zwei seltene Wochenbettkomplikationen. Muenchen. med. Wchnschr. 1895, p. 74.

Woman 31 years old, II-para, normal labor. Four days later pains and œdema of the left thigh; the groin was reddened and very sensitive. Slight rise in temperature several times during next few days. On the twenty-second day of the puerperium a sudden collapse set in with marked dyspnœa. At the same time there were marked pains in left calf, temperature 102°. Small vesicles began to form on left thigh and right leg. No pulsation was felt over left popliteal artery. On the thirty-first day the entire left leg was swollen and the skin discolored to a bluish black from the middle of the leg downward. The toes and the skin of the plantar pedis were entirely dried out and black. The line of demarcation established itself during the next few days at about the middle of the leg. The mummification made further progress. Two months after confinement amputation. Normal recovery.

The anatomical examination showed an embolus of the popliteal artery with continuation of the thrombus into the tibialis antica and postica arteries. The heart was intact. The author therefore explains the embolus of an artery of the lung (collapse and dyspnœa on the twenty-second day of the lying-in period) on the one hand as well as the embolism of the big artery of one of the lower limbs through an open foramen ovale (paradoxal embolism) (similar to Oliver's first case).

WILLCOX, FR. M. A case of tedious labor followed by double phlegmasia alba dolens and gangrene. Lancet, Lond., 1897, ii, p. 1188.

Patient 34 years old, I-para. Anæmic; otherwise healthy. Tedious labor, patient rather weakened. Forceps delivery, with laceration of perineum. First two weeks normal (temperature up to 99.5°). On the evening of the sixteenth day, very marked pains in left leg, phlegmasia. Elevation of left lower limb. On the twentieth day, the second toe of left foot became discolored, this discoloration next day continued up to the ankle. On the twenty-third day temperature 100.4°. Patient very feeble. Left foot next day was very cold, anæsthetic, and livid in color. Very pronounced pains. On the twenty-seventh day the abdomen was rather distended, the pulse small and irregular; these peritoneal symptoms subsided, but on the thirty-third day, a phlegmasia appeared also on the right lower extremity. On the thirty-sixth day, the patient died due to her extremely feeble condition. No autopsy. Author gives no explanation of the origin of the gangrene.

It seems that this gangrene was caused *only* through extensive thrombosis of the veins. This would be similar, then, to Winckel's case.

The same is illustrated also by an observation on a tuberculous boy of 18 years reported under the following title: Reyt, "Étude sur les gangrènes d'origine veineuse; un cas de gangrène du pied droit et de la partie inférieure de la jambe droite par oblitération veineuse avec intégrité des artères chez un sujet cachectique." Thèse de doct., Paris, 1897.

WINCKEL, F. Die Pathologie und Therapie des Wochenbettes. 3r ed, 1878, p. 312.

Patient 33 years old, II-para. During the night of the second and third day after a normal labor, chills and temperature up to 102°. Pains in abdomen. The veins of the right thigh became inflamed. Reddish discoloration and swelling, spreading from a few reddish and painful varices all over the right leg; a similar nodule on the left calf remained stationary. On the seventh day after labor, a vesicle was noticed on the right external malleolus. Three days later the whole foot up to the ankle was found to be cold, anæsthetic and of a bluish-red discoloration. From the next day on patient was delirious. The gangrene progressed and finally reached up above the middle of the leg. Moist gangrene. Death followed on the sixteenth day.

Autopsy showed putrid infiltration of the soft parts of the foot and leg. All the muscular veins contained putrid masses. Same findings in the popliteal and cruralis veins up to the groin. At that point, a soft putrid thrombosis was found in the crural vein. The arteries were empty. (Besides these findings there was a putrid pleuritis and pericarditis, (streptococci) abscesses of the kidneys, lymphangitis of the uterus, tumor of the spleen.)

In Winckel's case there was *only* a thrombophlebitis involving practically all the veins of the leg. The arteries were empty. This case like Willcox' case shows that gangrene can be due only to very extensive obliteration of the veins without an embolus or arterial thrombosis.

WORMSER, E. Ein weiterer Fall von puerperaler Gangraen des Fusses. Cor.-Bl. f. schweiz. Aerzte, xxxi, 1901, 545.

Wormser's second case: Patient, VI-para, 34 years of age, was admitted to hospital with fever due to suppurating prepatellar bursitis. Spontaneous delivery, followed by febrile puerperium. On the third day, incision of the prepatellar abscess, which healed promptly. Streptococci in the uterine lochia, on fifth day. From the eighth day on, gangrene of the left foot. Death on the eleventh day. Autopsy showed septic endometritis; thrombosis of femoral veins and foot veins, especially of small branches. The gangrene was of a purely venous type, with intact heart-valves and arteries. General sepsis due to streptococcus. Suppuration of symphysis.

WORMSER, E. Ueber spontane Gangraen der Beine im Wochenbette. Zentralbl. f. Gynaek., 1900, p. 1154.

Patient 23 years old, II-para; normal confinement.

On the seventh day the patient complained of pains in the left leg, especially in the calf; sensibility lessened on the inner side of the thigh; saphena sensitive. On the twelfth day pains in leg especially in foot increased; slight œdema. Finally a dry gangrene of the whole foot set in, with line of demarcation above the ankle. On the thirty-ninth day post-partum, amputation of the leg. Recovery.

Anatomical examination: There are no thrombi in the tibialis postica, but the arteries of the foot are filled with thrombi. All the veins are clotted. On the day patient was transferred to the surgical clinic a slight systolic murmur was found at the base which was not present before that time.

In this case the endocarditis without causing any symptoms was probably the cause of the embolism. (The endocarditis is not

essential to bring about an embolism as is proved in Winckel's case.)

ZBINDEN, E. Ueber Gangraen im Puerperium. Ergebn. d. Gynaek., 1914, p. 252. (This case is identical with that reported by Guggisberg, Verhandl. d. deutsch. Gessellsch. f. Gynaek., xv, Kong. ii, 213.)

Patient 25 years old, II-para. Four days after confinement slight mastitis on left side. Five days later patient out of bed. Seven days later recurrence of mastitis. On following day pains in both legs especially in calves and toes. Heart normal. Bluish spots on dorsal and plantar surface of right foot, and total analgesia up to about 1 cm. above malleoli. On the day following also bluish discoloration of left foot but its circulation was gradually re-established, with marked hyperæsthesia. Demarcation of gangrene on right foot.

According to Zbinden patient was discharged without amputation being performed whereas according to Guggisberg's above-mentioned communication the gangrenous part of the right foot was amputated. The author thinks that in this case the gangrene was due to ergotin because as he says the symptoms appeared simultaneously in both legs. I am rather inclined to believe that here too we have to deal with an infectious process (mastitis being present).

B. PUERPERAL GANGRENE OF THE UPPER EXTREMITIES

BILLROTH. Chir. Klin., Berl., 1871, p. 429.

Spontaneous gangrene of forearm of puerperal origin. Patient was a woman 35 years of age, near the end of her sixth pregnancy. Four days before an easy labor, at term, she felt pain in her left hand, and two days later the entire upper extremity was swollen, up to the axilla. Seven days after the onset of the pain, the fingers became blue, then black, and the gangrene rapidly invaded the forearm. Amputation of the limb, at the middle of the arm, on the twentieth day after the appearance of the pain. Complete recovery within one month after operation.

Billroth did not see this case himself, but from the description believes it to have been due to embolism of the ulnar artery, probably referable to endocarditis, with vegetations on the aortic valves. He states that he observed an entirely analogous case also originating during pregnancy, of spontaneous gangrene of the leg, in Zürich.

COMMANDEUR and GONNET. Phlébite double des membres supérieurs au cours de l'infection puerpérale. Soc. Obst. de France, 1909, Oct.

Bilateral phlebitis of upper extremities in puerperium. Patient II-para, 30 years of age. In third week following childbirth, sudden fever, pain, and thickening in area of veins, first of left arm then also of right arm, with œdema from finger-tips to axillæ. The lower extremities were intact. Repeated pulmonary embolism. Death on twenty-eighth day after delivery. Autopsy showed arm-veins up to the elbow as well as both cephalic veins filled with extensive blood-clot.

DICKINSON and HUBERT. A case of Raynaud's gangrene in connection with parturition. Tr. Clin. Soc., Lond., 1898, xxxi, 216.

CASE 1. Patient 42 years old, XII-para. Previously had symptoms of Raynaud's disease in the fingers of both hands. "After immersion in cold water her fingers would turn white and numb and then blue and painful." Two days after last confinement all the finger tips and both thumbs became itchy and painful. Discoloration followed and finally turned bluish-black. A few days later the toes were attacked the same way. Rough systolic murmur. Finally line of demarcation formed and some of the fingers were allowed to fall off, no operation being performed. (This is a pure case of Raynaud's disease.)

CASE 2. Patient 42 years old; IX-para; last child stillborn. Three months afterward symmetrical gangrene of fingers, toes, and ears. No subsequent history.

These two cases as well as Case 15 in Raynaud's original thesis and Begg's case, show a more or less close connection between symmetrical gangrene and parturition.

FRAENKEL, E. Ueber spontane puerperale Gangraen beider oberer Extremitaeten. Monatschr. f. Geburtsh. u. Gynaek., 1905, xxii, 781.

The patient was a primipara 24 years old. Spontaneous labor, followed by persistent fever. On the twelfth day of the puerperium, no arterial pulsation could be felt along the entire left arm, which was colder than normal, slightly discolored and swollen. Two days later, the pulse had also entirely disappeared in the right arm. Death on the next day (15th). No autopsy. The clinical course of the case indicated pure septicæmia, "without a clinically demonstrable localization." No lesion of pelvic organs. Complete blockage of the arteries of the upper extremities.

OSTERLOH. Gynaek. Gesellsch. zu Dresden; reported in Zentralbl. f. Gynaek., 1902, No. 17, 449.

Report of a case of bilateral embolic mastitis. Patient was admitted to hospital in a state of pronounced septic infection and promptly succumbed to the disease. She had moreover an abscess in the right lobe of the thyroid gland, and gangrene of the third phalanx of the fourth finger of the right hand, and the fifth finger of the left hand.

POPOW. Gangraen der oberen Extremitaeten im Puerperium. J. f. Geburtsh. u. gynaek., 1909, No. 8 (Russian); Zentralbl. f. Gynaek., 1910, No. 47, 1459.

Primipara, age 36 years, came under observation on eleventh day of puerperium, after a normal and easy labor, left arm was discolored almost up to elbow, covered with vesicles, cold, without sensation or motion; right arm was similarly changed on anterior surface of the forearm and in region of the fourth, fifth, and in part of the third finger. Rise of temperature had begun since fourth day of puerperium and patient noted first red, then purplish spots, with pain, in the arms, as outlined above. Lines of demarcation began to form on twentieth day after delivery, and the left arm was amputated at the upper third of the humerus. Resection of gangrenous portions of right arm, followed by transplantation of skin on the granulating surface. Patient made a good recovery. Old emboli were found in the left radial and ulnar artery, and a similar embolus was assumed in the right ulnar artery. The arterial walls were entirely unchanged. The veins were entirely permeable and empty. There had been no cardiac symptoms at any time, and there was no evidence of endocarditis. The emboli were therefore assumed to be derived from the uterine veins, whence they reached the general circulation through a patent foramen ovale.

SCHULZ, R. Mittl. a. d. med. Abt. d. herzogl. Krankenhauses zu Braunschweig; Deutsch. Arch. f. klin. Med., 1884, xxxv, 186.

Primipara, age 25 years, premature labor (7 months) at end of third week of typhoid fever. Soon afterward, after severe collapse, paresthesia and tingling sensations first in feet then in finger tips, with swelling of legs. In part

superficial, in part deep, gangrene of circumscribed skin areas in exactly symmetrical localities of the legs, upper and lower arms and chest. The fingers and toes were not gangrenous. Moderate pain in the affected limbs. No evidence of thrombosis, no thrombotic strands could be palpated. Recovery. The condition is referred by the observer to post-typhoid anæmia and resulting nutritional disturbances in the central nervous system.

SEIDELMANN. Deutsche. Ztschr. f. Nervenh., 1904, xxvii, 114.

Case of symmetrical gangrene of the upper extremities after pneumonia in a woman 29 years of age who about three weeks previously had been delivered of twins. Although the attack of pneumonia is credited by the observers with the responsibility for the onset of the gangrene he admits that a puerperal etiology cannot be altogether excluded in view of the relatively recent childbirth.

ZBINDEN, ERNST. Ueber Gangraen im Puerperium. Ergebn. d. Gynaek., 1914, 252.

The following case is identical with that briefly reported by v. Guggisberg in Verhandl. d. deutsch. Gesellsch. f. Gynaek., xv, Cong. vol. ii, 213.

Patient 26 years old, II-para. Three days after normal confinement chills and high temperature. On the ninth day very pronounced pains in the whole of right arm, œdema of same. A few days later cessation of pulse in ulnaris and radialis, no sensibility. First livid discoloration, finally bluish black color. Small vesicles on epidermis. Marked odor. Blood culture: hæmolytic diplococci, Gram positive. On fourteenth day after confinement systolic murmur. On seventeenth day after confinement amputation in the middle of the humerus for gangrene. Subsequently patient went through a very serious pyæmia but finally left the hospital cured.

Examination of amputated arm: The brachial artery is patent about 5 cm. below its bifurcation. There is an embolus to be found in the radial as well as in the ulnar artery occluding these two vessels entirely. Bacteriological examination of these emboli shows diplococci, Gram positive.

Author thinks that in this case the embolism was due to an existing endocarditis.

C. GANGRENE AFTER ABORTION—UPPER AND LOWER EXTREMITIES

ANDÉRODIAS. Gangrène des membres inférieurs pendant les suites de couches. Ann. Soc. d'obst. de France, 1901, 159.

Author's second observation (Lacouche's case). Patient, IV-para, 42 years of age with aortic stenosis; abortion at the sixth month. Two weeks later sudden severe pains in right groin; examination showed diminished temperature of leg and absence of femoral pulsation. Gangrene of the entire leg followed, leading to death on the tenth day. No autopsy.

BÉGOUIN and ANDÉRODIAS. Infection post-abortive, endocardite vegétante, embolie, gangrène d'un membre inférieur; amputation, mort. Rev. mens. de gynec., obst. et ped., de Bordeaux, 1901, p. 10.

The author's observation concerned a young woman, 26 years of age who after early abortion was attacked about two weeks later by extremely severe pain of sudden onset, especially marked in the right lower extremity, but also involving the left. Hazy and purplish discoloration, especially of right leg; this was cold more particularly at the level of the foot; no arterial pulsation, in pedal and femoral artery, on the left side the pedal artery was practically not felt, but the femoral pulsated normally. Progressive gangrene first appearing on the dorsum of the right foot and on the right knee; rapidly extending to a considerable portion of the foot and external aspect of the leg, as far as below the knee. The thigh remained warm and of normal color as far as three fingers' width above the knee. Amputation at middle thigh. Gradual arrest of pulsation in the left femoral artery, with appearance of large ecchymoses up to the knee.

Death 25 days after abortion. Autopsy showed the presence of vegetative endocarditis, affecting the mitral valve, and through its persistence after the amputation, giving rise to new emboli and repeated gangrene.

OKE. Cited by Simpson, Selected Obst. and Gynec. Works. 1871, p. 541.

Patient, age 24 years. Abortion at about 2½ months. On the following day she was seized with a severe headache, giddiness, dimness of vision, and vomiting. So great was the interruption to the vision that she could not distinguish the hands of a common clock. The fingers of the left hand felt as though scorched and were extremely painful. On the following day the dimness of vision continued and there was intense pain and numbness in the left arm which at length became cold and insensible to external impression. The wrist and the tips of the fingers were discolored.

On examination no pulsation could be felt in any of the arteries of the arm above the affected hand but the subclavian was distinctly felt pulsating above the clavicle. There was no perceptible disturbance of the action of the heart and no embarrassment of the respiration. This patient eventually recovered, with the loss by gangrene only of the integument of the thumb and fingers of the left hand. In three days the power of vision was restored. The pulsation never returned in the obliterated arteries of the left arm, but the arm itself gradually regained its sensibility and ordinary plumpness. Heart normal.

D. GANGRENE DURING PREGNANCY

HOFMOKL. Gangraena spontanea digiti minimi manus dextræ in gravida; enucleatio. Bericht d. k. k. Krankenanst. Rudolph-Stiftung in Wien, 1884, p. 412.

Case of spontaneous dry gangrene of entire little finger of the right hand in a young otherwise healthy pregnant woman. Patient a woman 28 years of age, eight days before admission to the hospital was suddenly attacked by pain, with reddening of the right little finger; the redness promptly subsided and the finger turned black. On examination this entire finger was seen to be black, mummified, and dry, up to the metacarpophalangeal joint. There was a distinct line of demarcation at the boundary of the gangrene. Two days later the gangrenous finger was removed; recovery. The entire process had no injurious influence on the course of the pregnancy, which was at the seventh month when the patient first came under observation.

JARDINE. A case of gangrene of the leg from thrombosis during pregnancy. J. Obst. & Gynæc. Brit. Emp., 1908, March, p. 190.

Primipara, age 22 years, came under observation in last month of pregnancy. In good health until eight days ago when pain appeared in the right foot and leg, with spasms and tingling sensations. The pains progressively increased in severity, and at the time of admission to the hospital the right foot and leg were pale, cold, and bloodless. No pulsation in artery of leg, weak pulsation in popliteal

space. Two days after admission forceps delivery of a hydrocephalic child, which died two hours later. No pulsation could be felt in the femoral artery and the thigh was very cold to the touch. Vesicles formed and the line of demarcation made its appearance just above the knee. High amputation of thigh. All vessels of the stump were thrombotic. The amputation flap became gangrenous and was destroyed. Pain, coldness, and absence of pulsation were likewise noted in the left leg for a few days, but the phenomena subsided again. The cause of the thrombosis could not be discovered, the cardiac condition could not have caused it, in the author's opinion.

MUELLER. Handb. d. Geburtsh., vol. ii, p. 955.

Patient 34 years old; I-para. Twelve years previously ulcus cruris on right leg. Eight weeks before confinement chills and fever. Eight weeks later a new chill and pains in right leg. Finally gangrene set in in right foot and leg. In this condition the patient was admitted to the clinic. Forceps delivery. Death 4 days later.

Post-mortem examination showed no thrombi in the larger veins, but old thin thrombi were found in the muscular veins of the legs. Nothing is stated about the arteries.

SWAYNE. Gangrene of the thigh during the seventh month of pregnancy. Tr. Obst. Soc. Lond., 1884, xxv, 215.

Swayne relates a case occurring during the seventh month of pregnancy. The disease came on after a long journey and attacked the integuments and muscles over the space of the size of a man's fist on the upper and inner third of the right thigh. The symptoms had existed about four days before the occurrence of premature labor, but were not very severe until after delivery, when they became much intensified, and proved fatal early on the third day. There was no injury, wound, or erysipelatous inflammation to account for the occurrence.

E. GANGRENE AFTER GYNECOLOGICAL OPERATIONS

CHATEL. Des Gangrènes en général et en particulier des gangrénes des extrémités. Thèse de doct. de Paris, 1904.

CASE 1. Gangrene of right arm following laparotomy for removal of a sarcoma of the left ovary. Patient woman of 53 years of age. Right hand and forearm became cold and painful on third day after the operation, and on the eighth day the arm was amputated, at the upper third (level of surgical neck). Not a drop of blood escaped from the gaping brachial artery in the stump. The vessels were ligated, although the condition was evidently hopeless, the arterial obliteration involving the axillary or the subclavian. Death four hours after the operation. No autopsy.

CASE 2. Death through gangrene of the entire left extremity, following an abdominal operation. Patient woman 50 years of age. Difficult removal of a multiple fibroma complicated by double salpingitis. On the evening of the operation, the patient began to complain of pains in the heel, promptly ascending to the root of the thigh. The entire limb became cold and lifeless. By the next morning the leg presented all the characteristics of arterial gangrene. There were no unfavorable symptoms on the part of the abdomen. On the following night the patient complained of some stiffness in the other leg and she died on the morning of the third day. Autopsy findings: Complete thrombosis of the arteries of the left limb, reaching as far as the aorta and extending also into the hypogastric artery. On the right side a clot (connected with the above clot at the bifurcation of the aorta) occupied the common iliac, but stopped at the bifurcation of the two iliac arteries, which were permeable. No peritonitis.

JESSETT. J. Obst. & Gynæc. Brit. Emp., 1904, vi, p. 181.

Gangrene of the leg, after abdominal hysterectomy, for a myoma weighing 28½ pounds. The leg became cold soon after the operation, and the line of demarcation formed above the patella. Amputation of the leg, fourteen days after the first operation. Death four days later. Autopsy showed thrombosis of the external iliac and nephritis, which had not been present at the time of the first operation. The gangrene had been dry throughout.

ROUX DE BRIGNOLES and AURIENTIS. Gangrène symmétrique des extrémités consecutive à une infection puerpérale. Marseille méd., 1910, xlvii, 577; Jahresb. f. Chir., 1910, xvi, p. 1336.

Abdominal hysterectomy, for a severe puerperal infection. On the day of the operation, bluish discoloration of the ends of the first three toes in both feet, followed by development of symmetrical gangrene. Amputation after line of demarcation had formed. Recovery. Patient was a primipara twenty years of age. The hysterectomy served as a life-saving procedure in this case of non-localized septicæmia.

ADDENDA

Through the great courtesy of Dr. Howard Lilienthal of this city I am able to add an interesting case of his to my paper and want to take this opportunity of expressing my appreciation to him. His case is *the fifth of gangrene after gynecological operations and the seventy-sixth in the whole series.*

H. Lilienthal's case: Post-operative embolic gangrene of fingers; amputation of fingers.

Mrs. R. K., 28 years old, entered Mt. Sinai Hospital on December 26, 1915. Temperature, 99.5°; pulse, 100; respiration, 24. Thirteen years before she had had post-abortive sepsis. Five years before she had been operated upon at Mt. Sinai Hospital for dysmenorrhœa. Four months before her appendix and right ovary had been removed in a hospital in another city and a ventral suspension had been done. At the same time an exploration of the upper abdomen had been made. The patient stated that a gastrotomy had been performed but as to this there is some doubt.

Menstruation had begun when the patient was 14 years old and for 13 years before admission had been very painful.

About ten days after the last operation there was sudden pain and tingling of the ends of the fingers of her left hand; two days later the skin of the hand and fingers began to change color; then dry gangrene of the fingers and of the end of the thumb developed. Her physician told her that he found sugar in her urine. There was a loss of 25 to 30 pounds in weight during the past month. The patient was in a very feeble and run-down condition on admission to the

hospital. The gastric symptoms were severe and there was a stomatitis and vaginitis which, however, gradually disappeared under ordinary oral and vaginal hygiene. All four fingers of the left hand were mummified until they were ready to be cast off. One or two cicatrices of ulcerations were seen in the forearm (Fig. 2).

The urine was normal. There was no pulse in the left radial artery and none in the brachial until near the axillary where feeble pulsations could be made out. There were no abnormal heart-sounds. The right pulse was feeble and small. Blood-pressure 87, 114.

Dr. E. Libmann examined the patient and stated that in his opinion the gangrene was due to peripheral arterial disease. On January 3, 1916, in nitrous oxide and oxygen anæsthesia, the fingers were amputated and there were several spurting vessels which had to be tied. No flap operation was made. The thumb was not operated upon. A Wassermann blood test showed double plus reaction. On January 6, the patient's condition having become steadily worse and an X-ray examination having shown an obstruction in the upper part of the jejunum an operation was considered inevitable, and an entero-enterostomy with suture was therefore performed. The patient gradually deteriorated although the vomiting ceased and three and one-half days later her pulse gradually became more feeble and she died. No signs of peritonitis.

A post-mortem examination through the wound was made by Dr. Thalheimer of the Pathological Staff. The death did not appear to be due to the surgical trauma nor were there any signs of infection. A patch the size of a quarter of a dollar was found in the aorta close to the ventricle and adherent to this patch was an organized clot a part of which had probably broken off and plugged the upper part of the brachial artery, thus accounting for the digital gangrene.

A report of the necropsy follows (heart and aorta only).

The heart is rather small, very pale and the epicardial surface is mottled in appearance. The myocardium is pale and cloudy; heart otherwise normal.

The aorta shows throughout large numbers of small, irregular areas which have the appearance of subintimal fatty changes. The isthmus of the aorta is narrow and at the region of the ductus arteriosus there is an irregularly circular thickened area of the aorta, about 2 cm. in width. The intima over this is somewhat raised giving this area the appearance of an inverted button. The intima also appears œdematous and adherent to the intima is a mixed thrombus mass, 2 by 3 cm. in size and 0.5 cm. in height. The aorta beneath this thrombus is twice as thick as it is elsewhere. On section the intima over it is greatly increased in thickness and appears œdematous. The ductus arteriosus is obliterated and the pulmonary artery over it shows only a very slight irregularity of the intima.

Diagnosis. Aortitis (syphilitic?). Localized thrombosis of the aorta.

POST-OPERATIVE HEATSTROKE[1]

By ALEXIS V. MOSCHCOWITZ, M.D., F.A.C.S., New York
Professor of Clinical Surgery, College of Physicians and Surgeons, Columbia University; Attending Surgeon, Mt. Sinai Hospital; Visiting Surgeon, Har Moriah Hospital

LATE in the evening of September 9, 1915, I was requested by Dr. Spinner to see Louis L., 7 years of age, who had been ill for two days with symptoms of acute appendicitis. I concurred in the diagnosis, and the boy was admitted to my service at the Har Moriah Hospital. As the symptoms and physical signs were quite mild, operation was deferred until the next regular operating day, which was the day following his admission.

Operation September 10, 1915 at 2.30 p. m. An acutely inflamed subcæcal appendix was removed through a Kammerer incision. An abscess containing perhaps a teaspoonful of pus was encountered near the base of the appendix; the wound was therefore drained with a cigarette drain. The incision was closed by layer suture. One hour later the child had to be redressed (in anæsthesia) because the drain had become disarranged.

After operation the boy was noisy and restless, at 8 p.m. I was notified by the house surgeon, that the temperature had risen to 105.6° F. and the pulse rate to 120. As there was nothing in the surgical condition of the patient to warrant even remotely so high a temperature, I made a diagnosis of "post-operative heatstroke." I therefore ordered an ice cap to the head, and sponging of all the exposed parts of the body with ice water; the pulse was stimulated with camphor, strychnine and caffein; the course of the temperature can be seen on appended chart (Chart 1); it reached a maximum of 109° F. at 4 a.m., of September 11.

At 8 a.m. the boy had a convulsion, which lasted twenty minutes; at 9 a.m. there occurred a second

[1] Read at a meeting of the Surgical Section of the New York Academy of Medicine, April 9, 1916.

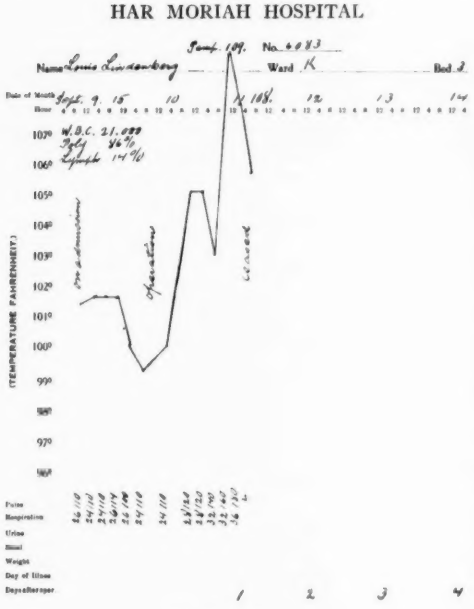


Chart 1, Case 1.

convulsion which lasted fifteen minutes; the pulse became imperceptible, and at 11 a.m. the child died.

Much to my regret, we were unable to obtain a post-mortem examination, but from past experience, I have not the slightest doubt, that this was an authentic case of heatstroke.

At this point it is only proper to call attention to the fact, that during the first half of September 1915, New York City was suffering from a heat wave of unusual length and severity. September 10 in particular is featured by the *New York Sun* as being almost the hottest day of the year.

On the same day I was invited by Dr. Eli Moschcowitz, Pathologist to Beth Israel Hospital, to witness the autopsies of two patients who died with unexplained high post-operative temperatures. The autopsy did not reveal anything unusual, and certainly nothing to explain the high temperatures; it was the pathologist's opinion, that both patients died of post-operative heatstroke. I am greatly indebted to Dr. Harry E. Isaacs, Attending Surgeon to Beth Israel Hospital, for his permission to incorporate a brief history of these two cases.

CASE 2. Ike R., age 38, was admitted September 6, 1915. During the preceding six years the patient had been suffering from frequent attacks of pain in the right lumbar region, which radiated downward and inward. Lately similar attacks occurred upon the left side also; for two days prior to his admission to the hospital, the patient vomited very frequently, and his bowels moved only with the aid of enemata. The urination was not increased in frequency.

On physical examination there was elicited tenderness on deep pressure over the entire abdomen, particularly marked in the vicinity of the umbilicus. In other respects the physical examination was of no importance.

The patient was operated upon by Dr. Isaacs, September 8, at 5 p.m. Abdominal incision was made through the left rectus, five inches in length. The omentum was adherent to the sigmoid flexure. On separating the adhesions the omentum was found to contain an abscess; this portion of it was therefore resected and a cigarette drain was inserted to the sigmoid flexure. The wound was closed in layers.

Even before the operation the patient had been running a temperature up to 102° F.; therefore a post operative rise to 103° F. on the following morning, was not very surprising. However, barring an intercurrent drop of two and one-half degrees for a few hours in the afternoon, the temperature continued to rise, reaching 107.8° F. at 6 p.m. of the following day, and shortly thereafter the patient died (Chart 2).

A careful autopsy was performed a few hours later and following anatomical diagnosis established. "Chronic congestion of lungs, with acute hypostasis; chronic congestion of liver; chronic congestion of spleen; chronic congestion of kidneys; localized peritonitis in the region of the sigmoid flexure." In the absence of any findings explanatory of the high temperature, the pathologist arrived at the diagnosis of "post-operative heatstroke."

CASE 3. Gussie G., age 30 was admitted September 6, 1915, to Beth Israel Hospital. Patient was operated upon one year ago for cholelithiasis; no relief however was obtained; on the contrary the operation was followed by jaundice, which had not existed before. Operation September 8, 1915, by Dr. H. E. Isaacs. Exposure of the common duct, through a five-inch longitudinal incision in the right hypochondrium. Enormous adhesions were encountered, which made the exposure of the duct somewhat tedious. The common duct was found to be distended and to contain several calculi; after incision of the duct, these were removed. Drainage by two tubes, one leading into the hepatic duct and the second into the common duct toward the papilla of Vater.

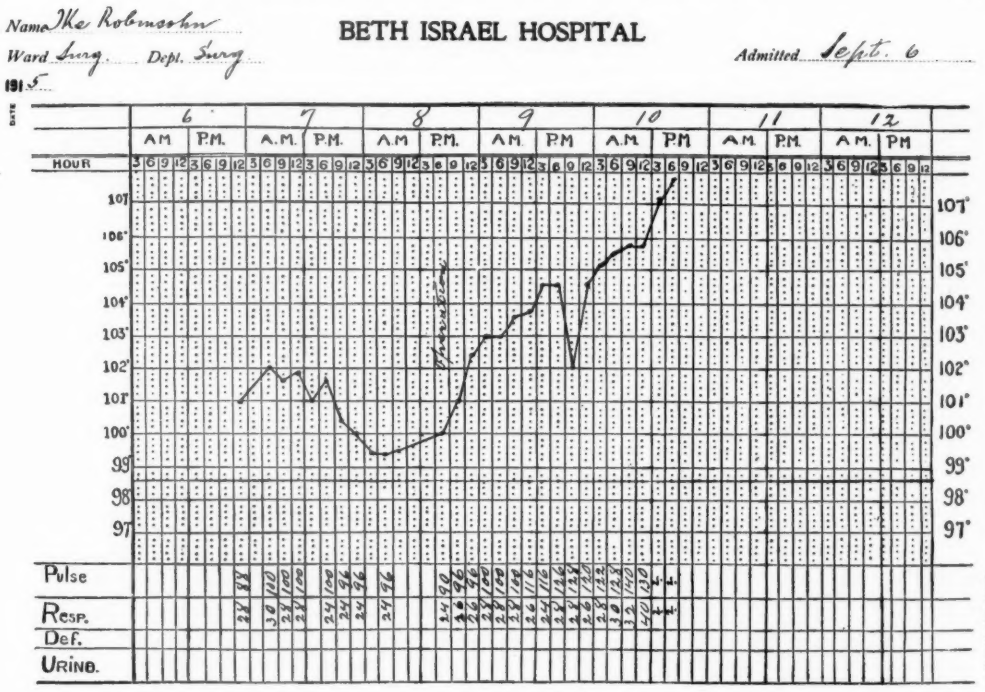


Chart 2, Case 2.

After the operation the temperature began to rise slowly but steadily; it reached 103° F. next morning, 104° F. in the evening, 105.6° F. next morning, and a few hours later the patient died with a temperature of 106.8° F. (Chart 3).

An autopsy was held on the same day and the following anatomical diagnosis was made by the pathologist. "Recent choledochostomy, with recent localized peritonitis; brown pigmentation of the myocardium; chronic congestion of the liver with fatty infiltration; acute hyperplasia of the spleen; chronic pancreatitis; chronic congestion of the kidneys, with parenchymatous nephritis."

In view of these findings, and in view of the fact that the patient died thirty-six hours after operation, with a temperature of 106.8° F., it was the pathologist's opinion that the cause of death was "heatstroke."

I have been on active summer service at Mount Sinai Hospital regularly every year from 1899 to 1914, and have often had the impression that during particularly hot weather some of my patients suffered from a mild insolation; however, I find in my histories only the following case reported as an actual and undoubted case of post-operative heatstroke.

CASE 4. Benjamin A., Russian, age 34, was admitted to Mount Sinai Hospital, August 7, 1900. His principal complaints were cyanosis and pain of the foot; he has had a number of intractable ulcers in the vicinity of the toes, resulting progressively in their total loss. He was treated at that time for Raynaud's disease, but there is no doubt that he was suffering from what we now designate as thrombo-angiitis obliterans.

The pain was so severe that I finally acceded to the wishes of the patient and consented to amputate the leg. Amputation August 11, 1900 through the knee-joint, by the Ssabanjeff method. The patient did not react well from the operation, and he was also noisier than usual. One and one-half hours after operation the temperature rose to 104° F.; four hours later the temperature was 108.2° F. The patient was in a stuporous condition; the skin was hot and dry. Insolation was suspected; therefore an ice pack was ordered. The pulse became imperceptible, and was apparently uninfluenced by active stimulation. The patient died seven hours and forty minutes after operation, with a temperature of 106.5° F. (Chart 4).

Autopsy twenty hours post-mortem showed all

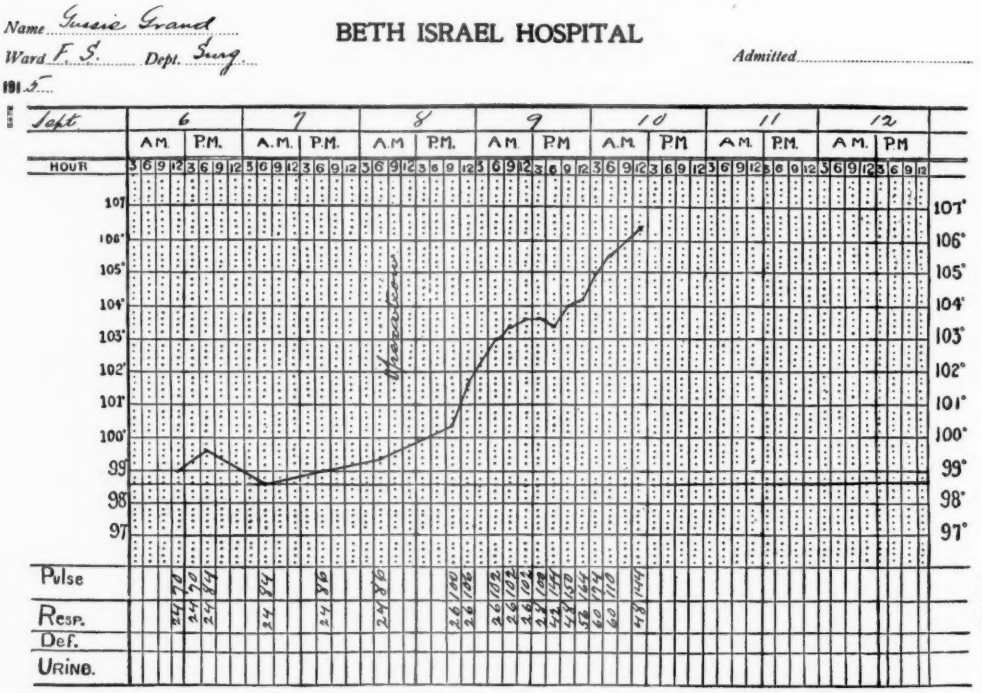


Chart 3, Case 3.

the organs normal, with the exception of a chronic parenchymatous nephritis of a slight degree. Examination of the vessels upon the surface of the brain showed a marked congestion of the vessels upon the surface of the brain. Some increase of the cerebrospinal fluid, with dilatation of both ventricles. Cut section of the brain showed a congestion of the vessels. The sinuses of the dura were found to be normal. At that time we looked upon these findings, as distinctly corroborative of our diagnosis of post-operative heatstroke.

The summer of 1900 must have been a particularly severe one as regards heat and humidity, because the only medical article published with post-operative heatstroke as its subject dates back to that year. I refer to Gibson (1) who reports two cases of post-operative heatstroke, which occurred during the preceding summer in his service at St. Luke's Hospital. The history of these two cases is the following.

CASE 5. Walter O. C., age 8, was admitted June 1, 1910, with an attack of appendicitis of moderate severity. Temperature 102° F., pulse 120. Immediate operation in gas and ether anæsthesia; a gangrenous appendix was found and extirpated; gauze drainage; partial suture of wound. Immediate recovery was good until the afternoon of the next day, when the symptoms were such as to cause the gravest anxiety. The temperature was 104° F.; pulse 148 and very poor; countenance pinched; color ashy grey-blue; skin hot and dry; some delirium. The condition of the wound was perfect. Ice packs and alcohol sponge baths reduced the temperature, whereupon the delirium also ceased and was followed by a refreshing sleep. The case thereafter terminated in a prompt convalescence.

CASE 6. Charles Van E., was admitted to St. Luke's Hospital with an acute appendicitis. The patient was extremely obese, weighing more than three hundred pounds. Heart action feeble and intermittent. Temperature 104.4° F. Immediate operation; evacuation and drainage of a huge abscess, and extirpation of a gangrenous appendix. One and one-half hours after operation the temperature rose to 108.2° F. Ice packs and an ice coil to the abdomen and head brought the temperature down to 102.8° F.; thereafter the temperature fluctuated between 101° F. and 102° F., and was very probably due to absorption from the abscess cavity. Two weeks later the patient was considered to be convalescent, when he suddenly died. Autopsy showed the death to be due to the cardiac condition.

Gibson read this paper at a meeting of the Surgical Section of the New York Academy of Medicine, November 12, 1900. The paper as reported in the *Journal of the American Medical Association*[1] created considerable discussion, as is evidenced by the following additional case reports.

CASES 7, 8, and 9. Johnson reports a case in a child, of excision of a cicatrix from the lower lip, with a single skin graft. The temperature of the operating-room on that particular day was 102° F. Within a few hours after the operation the temperature of the child rose to 108° F.; death occurred the same night A few days later Johnson had two similar cases, but this time prompt treatment with ice packs was instituted, and was followed by recovery.

CASE 10. Brewer reported a case of extirpation of the tonsil for sarcoma. The temperature of the operating-room was 99° F. Two hours after operation the temperature of the patient rose to 105° F., and the pulse to 150. There was also delirium. Prompt treatment with ice packs was followed by recovery.

Crandon and Ehrenfried (2) state that they have seen three cases of post-operative heat or sunstroke. The history of the following case only is given.

CASE 11. Boy, 23 years of age, was admitted with an acute appendicitis of three days' duration. Temperature 103° F.; pulse 120. The street temperature in Boston on that day was 100–101° F., with excessive humidity. Immediate operation; a gangrenous appendix with a large abscess was found. The condition of the patient was very good on leaving the operating table. One hour later, however, there was a sudden rise of the temperature to 107° F., and the pulse to 180. The skin was dry and red; the tongue and lips were dry. The eyes were glistening; the patient was irrational. Ice packs brought the temperature down to 100° F., in twenty-four hours; thereafter convalescence was normal.

I am indebted to Dr. Cunniffe for the history of the following unpublished case of post-operative heatstroke.

CASE 12. Miss C., while visiting in the country, was suddenly seized with severe general abdominal pains, which soon became localized in the right iliac fossa. Six hours later she was seen by her physician, who diagnosticated an acute appendicitis, and referred the patient to Dr. Cunniffe for immediate operation. The patient was transferred to a sanitarium, a distance of eight miles, in an open automobile, without adequate protection from the sun, on July 4, one of the hottest days of the summer of 1912.

[1] 1900, December 29, p. 1685.

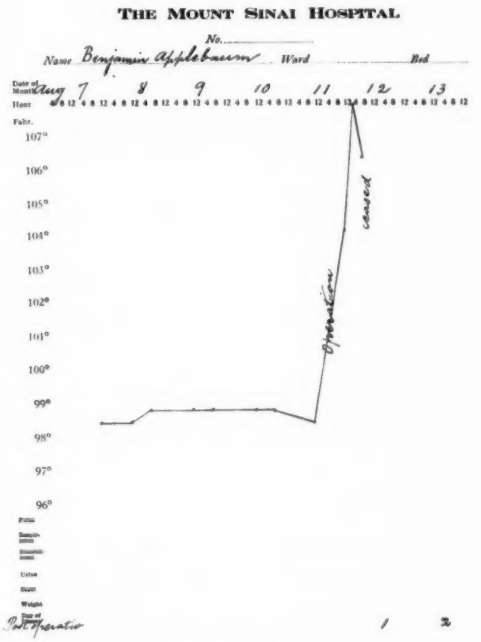


Chart 4, Case 4.

The patient was operated upon at 3 p.m. Intermuscular incision was made. On incising the peritoneum a small amount of serous fluid was found; a swollen and congested appendix was extirpated; the wound was closed without drainage. The patient was returned to her room at 3.40 p.m., in good condition. Two hours later the temperature of the patient rose to 106.8° F. A diagnosis of heatstroke was made and prompt treatment with ice pack instituted. The temperature remained very high throughout that night. On the following day it ranged from 101 to 102° F., and did not reach the normal until July 9. The wound healed by perfect primary union.

The literature dealing with the symptom-complex, caused by exposure either to the direct rays of the sun or to high degrees of artificial heat, is exceedingly voluminous. The references appended to Steinhauser's monograph *Nervensystem und Insolation*[1] cover over twenty-two closely printed pages, and in addition the statement is also found that only the newer literature, approximately that after 1880, has been considered. However, even with such a wealth of material

[1] Berlin: Aug. Hirschwald, 1910.

there exists no unanimity regarding the disease. After a very careful study of the more important contributions to the subject, I have arrived at the conclusion that our knowledge as to the etiology, symptomatology, pathology, and treatment of the disease is in a chaotic state. If this is true of heatstroke or sunstroke in a general sense, a disease so common as to be at times epidemic or endemic in nature, how much more likely is it to be true of that small and selected group which particularly interests us at present, namely, post-operative heat- or sunstroke. Altogether, as is seen, there have been reported in the literature only the two cases of Gibson; a few more were mentioned in the discussion of Gibson's paper. Three additional cases were mentioned casually in a textbook dealing with post-operative treatment. Thanks to the courtesy of my colleagues, and from my own experience, I am able to add five more cases. In other words, a total of barely twelve cases, scattered through more than fifteen years, is all that is available for study. My personal experience is limited to two positive cases, and a third doubtful one; certainly an insufficient number to entitle me to discuss authoritively the many moot problems, where others with a wealth of material have failed; and yet even with this limited material, I have gained certain well founded impressions, which I consider worthy of record.

The most prolific contributors to the subject of insolation have been the military and naval surgeons of the United States, Great Britain, and Germany. All of these, as well as the civilian recorders of certain large epidemics in New York, Philadelphia, and Boston appear to be agreed that there exist various forms of insolation. All writers differentiate clinically at least two forms, namely "sun- or heat-stroke" and "heat prostration." a few authors describe also a third form, "heat exhaustion," so called.

As near as I can gather from the observations of the best authorities, "sunstroke" is characterized by the following more important attributes, in addition to other less important, or secondary attributes. There is always a history of direct exposure to the sun, and of an abrupt onset, with complete loss of consciousness. The integument is, as a rule, hot and dry and flushed. The body temperature is very high; the pulse is full and of high tension. On the other hand in "heat prostration" these symptoms are either lacking, or their exact antithesis is present. Thus we find that there is no history of direct exposure to the sun, but on the contrary a history of being confined in a close, poorly ventilated room, and perhaps of exposure to artificial heat. The best examples of this form of insolation occur in stokers on steamers, and may occur even when the outside temperature is far below what is usually termed hot. The onset is gradual and consciousness is usually retained. The skin is not hot, dry and flushed, but on the contrary is cold, clammy and pale. The temperature in these cases is variable; it may be either normal, or subnormal, or may even be elevated; but in instances of the latter it never attains the height it attains in cases of sunstroke, rarely going over 102° F. The pulse, in contradistinction to the former, is weak and thready.

Let us now see how far cases of post-operative insolation correspond to these requirements.

If we except the case of Dr. Cunniffe, the case that on the day of the operation rode to the sanitarium in an open automobile, inadequately protected from the rays of the sun, all of the cases reported had been sick, either at home or in a hospital, for a number of days prior to the operation, and were therefore at no time exposed directly to the sun. Assuming now that the symptomatology previously discussed is correct, it should follow also that cases of post-operative insolation are not cases of "heatstroke" but of "heat prostration."

Nothing definite can be said regarding the rate of onset of the disease, because all cases of post-operative insolation were operated upon in general anæsthesia; therefore the rapidity of the onset, or the lack of it, cannot be estimated at its true value. By the time the patient has fully reacted from the anæsthesia, the disease may already be far advanced, or it may have just begun.

In most of the cases, in which the integu-

ment is mentioned at all, we find it stated that the skin of the patient was very hot and dry; in one or two a peculiar cyanosis is mentioned. This therefore would be a symtom which is certainly more characteristic of heatstroke than of heat prostration.

I fear that not much reliance can be placed upon the quality, character, or rate of the pulse. Soon after an anæsthesia, with its complicating nausea and vomiting, the rate and character of the pulse is apt to vary to such an extent, as to detract from its value as a differentiating guide.

In all of the reported cases, however, we find it emphasized that the body temperature was extraordinarily high; we thus find recorded the following temperatures: 109°, 108.2°, 108.2°, 108°, 107°, 106.8°, 105°, and 104°; as a matter of fact it might be said that it is practically only upon the presence of these excessively high temperatures, and even in the absence of any or all symptoms, that the diagnosis of post-operative insolation has usually been made. The registration of the temperature by a thermometer is so exact, and so absolutely uninfluenced by the personal equation of the observer, that we must look upon it as absolutely reliable in every respect. Judging from the high temperature alone it would follow that all of the cases hitherto observed or recorded belong in the group of heatstroke, and not heat prostration.

Almost involuntarily, however, there arises the question, as to whether the above conclusion that all cases of post-operative insolation are cases of heatstroke and not of heat prostration, and it is a justifiable one. Let me for the sake of argument mention the following hypothetical case: A patient is operated upon, let us say, for an acute gangrenous appendicitis with abscess; six hours after operation the temperature may be either normal, subnormal, or slightly elevated; the skin is cold, clammy and pale; the pulse is weak and thready; and finally let us assume that this operation took place on a hot July or August day. Upon the following day the condition either persists or it is already improved. Ultimately the case recovers with out any sequelæ, or the case dies within the first forty-eight hours. There is not a surgeon who has not seen such cases. No one ever thinks of making any other diagnosis than that of mild post-operative shock, or ordinary rather severe post-operative reaction; and yet are not the hypothetical symptoms just enumerated, and the history and course, characteristic of so-called heat prostration? I wonder how frequently these cases are overlooked; is it not probable that this is the most frequent form of post-operative insolation; more particularly as it is *the* form which is more likely to occur in the absence of direct exposure to the sun?

It is not at all remarkable that the few cases of post-operative insolation have been recorded in two cities only; namely, Boston and New York. As I believe these two cities, with the addition of Philadelphia, record also the greatest number of endemic or epidemic heat prostrations. I do not suppose that there is anything in the geographical location of these cities to account for the greater frequency, as even the larger cities further south, with presumably higher temperatures, fail to report as many cases in proportion. It is, perhaps, possible to account for the greater frequency of heatstroke in these three cities by the fact that they are more compactly built up, and that it is in these cities only that many of the inhabitants live crowded together in tenements.

Trivial as it may appear, I believe a second important reason for the greater frequency of heat prostration in these cities is to be looked for in the fact, that their population has not as yet learned to dress properly during the summer. I believe, in fact I know, that most of the people wear too much, too heavy, too dark, and too woolly clothing; and I am also convinced, that all of these are conducive to the production of heat insolation.

I also believe that the suggestions just made have an important bearing on the question of the production of "post-operative" heatstroke. The real hot days of the year are in the very smallest minority in New York City; the great majority of the days of the year are either cold or verge at least upon coolness. On this account surgeons have learned to fear so much the occurrence of

post-operative pneumonia that they try to avoid it, by instructing their nursing staff to be sure to cover the patient well in the operating-room, upon the transport to and from the operating-room, and upon the arrival in bed. This has become a sort of fetish and an inviolable rule. I have not the slightest doubt that this needless superheating of the patient is conducive, in a great measure, to the occurrence of post-operative insolation.

It was my intention to fortify my standpoint regarding post-operative heatstroke by quoting the unusually high temperatures of New York City on those particular dates. In this, however, I was doomed to disappointment. I consulted the files of the *New York Sun* upon the four dates upon which cases of post-operative insolation are known to have occurred; and was rather surprised to find that with the exception of September 10, 1915, on which a temperature of 90° F. was recorded, the temperature on the other dates was considerably below that; namely 83° F. June 1, 1900; 89° F. Aug. 7, 1900; and 83° F. July 4, 1912. A little reflection soon convinced me of my error. It was well known to me that the deleterious effects of the heat are due, not so much to the excessive height of the temperature on a particular date; but more to a long continued term of fairly high temperature, with a very high percentage of humidity, and absence of any breeze; in other words what is commonly called a "heat wave." The longer the atmospheric conditions just described exist, the greater will be the number of heat prostrations. When I again consulted the files of the daily press upon the dates mentioned from this viewpoint, I found just the conditions described and also that they had been in existence for some time preceding that date.

TREATMENT

Whenever the atmospheric conditions are favorable for the production of insolation, all operating-room activities should cease, with the exception of those of an urgent nature. It is quite within the range of possibility that insolation may occur even in a non-operated individual, but the exhaustion dependent upon the operation is lacking, and may be just the factor which determines the occurrence of insolation, and the success or failure of the treatment instituted.

In all cases operated upon during a hot wave, the greatest regard should be had for the comforts of the patient. As already indicated all the needless swathing in blankets and hot water bottles is to be prohibited. On the contrary at such times coolness and the lightest of covers are indicated. Motor fans are also in order and desirable. Cooling drinks should be permitted much earlier than is generally the custom after operations.

It has already been pointed out that thus far only that particular form of insolation which is characterized by very high temperatures and which is called "heatstroke" has been recognized as a post-operative complication. This is perhaps due to a lack of our diagnostic acumen; as it is quite possible that the second variety, or "heat prostration" so called, is the more frequent. While the etiological factor appears to be identical in both, they differ widely in their symptomatology, and what is of the greatest importance also in the therapy.

In heatstroke the temperature is so high that every effort should be made to reduce it, and to nihilize its deleterious effects. Unfortunately we cannot avail ourselves in these cases of the antipyretic properties of the coal tar products, on account of their depressing effect upon the heart. Recourse must be had, therefore, to physical measures to reduce the temperatures. The best of these is hydrotherapy properly executed and carried out, in the form of sponge baths with iced water. An ice cap applied to the head is not only grateful to the patient, but materially assists in reducing the temperature, and in combating the delirium of the patient. Enemata or Murphy infusions with ice water, coming into contact with a large volume of the superheated blood should also be tried, and will also be followed by success. This form of treatment would, on the other hand, be entirely contra-indicated in that variety of insolation, which we call heat prostration. In this form the temperature is not only not elevated, but in many cases is even subnormal. The exact opposite form of treatment is

therefore indicated, namely the patient should be well covered and surrounded by hot water bottles; subcutaneous or intravenous saline infusions, or warm rectal infusions, are indicated.

The rate and quality of the pulse is to be controlled, and forms a valuable guide as to the character and amount of stimulation called for.

In a certain number of cases of insolation there has been found a peculiar degeneration of the blood, which manifests itself by a laking. This suggests the possibility of venesection and blood transfusion, provided a suitable donor can be found at short notice.

REFERENCES

1. Gibson. Med. News, 1900, Dec. 8, p. 883.
2. Crandon and Ehrenfried. Surgical After-Treatment. 1912, p. 109.

PERFORATION IN TYPHOID FEVER

With Report of a Case Associated with Acute Typhoid Appendicitis in a Child Aged 7; Recovery[1]

By IRVING H. EDDY, M.D., Chicago
Instructor in Gynecology, College of Medicine, University of Illinois

In discussing this most important topic of surgery one cannot refrain from praising the courage of the early workers in this field. In 1884, von Leyden first proposed to treat the resulting peritonitis of typhoid fever through operative measures and at that time said:

> I cannot longer forbear mentioning something I have for a long time had in mind, namely, whether or not it is possible to treat peritonitis by operative measures. The idea is rational enough when one considers that suppurative peritonitis is very similar to suppurative pleuritis.

Further he says:

> But I must leave it to the surgeons to determine whether it is possible to accomplish anything by operation in this condition, but one thing is certain, it seems to me, that herein lies a most fruitful field for investigation.

During the same year appeared an article by the renowned Mikulicz in which he reported three cases of peritonitis treated surgically, and there is little doubt that one of them was a perforated typhoid ulcer. While there is some doubt as to the authenticity of this case, there is no doubt that Mikulicz's great teaching encouraged the surgical treatment of peritonitis.

Lucke and Kussmaul, however, seem to receive the credit of being the first to have operated on and reported an authenticated case of perforation. During the same year, Bontecou reported a case. To Professor J. C. Wilson, in 1886, is given the credit of being the first writer on the subject in the English literature, and at that time he made the following statement:

> Granted that the chances of a successful issue are against you, that the lesion of the gut may be very extensive, that the vital forces are at a low ebb, nevertheless the courage to perform it will come of the knowledge that the only alternative is the patient's death.

As early as 1762, A. G. Richter, of Vienna, suggested the advisability of draining the peritoneal cavity for suppurative peritonitis. Among early writers on the subject especially are to be mentioned Keen, Cushing, Finney, Van Hook, and others. In 1898, Keen published his extensive monograph "Surgical Complications and Sequels of Typhoid Fever." in which he reported a collection of 83 cases from the literature and, in 1899, collected 75 additional cases, making a total of 158 cases operated on, with a mortality of 76.59 per cent, the mortality of non-operative cases being quoted by Murchison as 95 per cent. At this time Keen made the following statement:

[1] Read before the Chicago Medical Society, April, 12, 1916.

The earlier the moment at which the operation can be done after the immediate shock of the perforation (provided, of course, there has been any as is sometimes not the case), the better it will be for the patient; every hour thereafter counts, since the infection of the peritoneum becomes more diffuse and intense.

In discussing the above, Cushing made the following reply:

It is hard to understand Dr. Keen's advocating delay until symptoms of shock have passed away and his preference of the second twelve hours for operating, when one appreciates that extravasation perhaps of virulent organisms is with all probability continuously taking place while we are waiting.

In Keen's statistics in which the time was given before operation, the results were as follows:

	No. of Cases	Died	Recovered
Operated on during first 12 hours	36	29	7
Operated on during second 12 hours	39	27	12
Operated on after 24 hours	83	65	18

FREQUENCY OF PERFORATION FOUND AT AUTOPSY

The frequency of perforation varies greatly, as is shown by the following statistics of various epidemics:

In a series of 105 autopsies at Johns Hopkins Hospital, perforation was found in 30 cases and occurred more frequently in ulcers with adherent sloughs. In Munich, in a series of 2,000 autopsies, perforation occurred in 5.7 per cent.

Author	Autopsies	Percentage
Murchison, 1st series	435	13.8
Curschmann	575	16.
Heschel, Brouardel, Thoinot	2,667	7.
Mackenzie*	1,037	33.7
Murchison, 2d series	165	21.2
Heschel, 1840–1849	1,271	4.4
Brouardel and Thoinot†	1,721	11.03
Greissinger	118	11.8
Osler	6,819	12.

*Various London hospitals.
†From English, French and German Sources.

The United States census reports of 1900 give the total deaths from typhoid fever as 35,379. As 12 per cent of the total death-rate is shown to be due to perforation, there died during that year in the United States 4,422 from perforation of the bowel.

FREQUENCY OF PERFORATION AS TO NUMBER OF CASES TREATED

	No of Cases	Percentage
In Leipzig	1626	2.2
In Hamburg	4094	1.6
Greissinger	600	2.3
Johns Hopkins Hospital	829	2.7*
Murchison	1589	3.
McCrea, Montreal	717	6.
Mackenzie, London	9731	3.6
Hare and Brisbane	3723	2.9
London and French Hospitals	8356	3.4
Scott, Philadelphia	3006	2.6

Total average = more than 3 per cent.

*Three recovered by operation.

LOCATION OF PERFORATION

Author	Ileum	Colon	Appendix	Meckel's diverticulum	Jejunum	Cæcum	Rectum	Mes. G.
Including Osler's with those of Leibermeister, Mackenzie, and Fitz	506	56	32	4	4	1	1	..
Curschmann, 64 cases	51	11	1	..	..	..	1	..
Scott, 50 cases	43	1	4	..	..	1	..	1
Hawkes, 72 cases	61	5	3	..	..	3	..	..
Total	661	73	40	4	4	5	2	1

The location of perforation relatively coincides with the studies of Baer as to the location of ulceration, which is as follows:

	No. of Cases	Per Cent
Ileum	1,423	89
Cæcum	1,396	30.3
Jejunum	1,358	5.9
Ileocæcal valve	89	6.7
Ascending colon	621	10.3
Transverse colon	621	4.5
Descending colon	621	2.6

TIME OF PERFORATION

Finney analyzed 112 cases with 66 perforations occurring as follows:

20 during the second week.
36 during the third week.
9 during the fourth week.
The shortest period was four days.

In 193 cases Fitz found that perforation occurred in 88 cases during the second and third weeks, while 90 per cent of the remainder occurred during the fourth, fifth, and sixth weeks.

AGE

	Less than 15	1–10	10–20	20–30	30–40	40–50
Author.....						
Finney.....	8	..	..	38	25	..
Osler.....	..	3	10	15	6	6
Fitz.....	..	7	46	77	45	14

In Finney's series the youngest was 0 years. In Scott's series of 153 cases, only 5 were less than 15 years of age, the youngest being 8 years.

According to Curschmann, Topin, Rilliet, Rocher and Henoch, children under ten years of age are less prone to perforation, and that pathological study shows that the medullary swelling of Peyer's patches and the solitary follicles is not so great as in adults, diarrhœa not so common, and sloughing not so marked, which undoubtedly explains the low percentage of perforation. This statement, however, is disputed by Jopson, who collected 45 cases, the age being given in 44 as follows:

Age	Cases	Age	Cases
5	4	11	2
6	4	12	4
7	2	13	3
8	7	14	5
9	4	15	3
10	6	..	..
			Total 44

In 2,274 cases among children collected by the same author, perforation occurred 35 times, or in 1.5 per cent as compared with the previous table in which perforation occurred in more than 3 per cent. Further, one may note that only 21 of the 44 cases reported by him were under 10 years of age. The fact that only 21 cases under 10 years of age could be found in the literature to 1909, the time of his article, proves in itself the infrequency in children. Griffith and Ostheimer, in 302 cases under 2½ years of age, found perforation in 2 cases, the youngest found in the literature.

SEX

In 444 cases, Fitz reports 71 per cent in males and 29 per cent in females.

MORTALITY

Of 16 cases operated on at the Johns Hopkins Hospital, between 1890 and 1900, 6 recovered.

Keen's reports show 158 cases operated on, with a mortality of 76.59 per cent.

In Jopson's series, the type of disease was given in 31 cases as follows: mild, 8; moderate, 15; and severe, 9. Of the mild, 5 recovered, 3 died; of the moderate, 8 recovered, 7 died; of the severe, 2 recovered, 6 died—a mortality of a little more than 50 per cent.

Scott's reports from the Pennsylvania Hospital were as follows:

	No. Cases	Total deaths	Perforations	Operated On	Not operated On	Recovered
May 1901 to 1902	509	35	8	5	3	0
May 1902 to 1903	749	55	17	13	4	6
May 1903 to 1904	690	63	24	19	5	6
Total	1948	153	49	37	12	12

Of the 37 cases operated on, 12 recovered; the mortality being 67 per cent.

ETIOLOGY

Of the conditions that favor perforation, we know comparatively little; however, when one examines the bowel with ulceration almost to the peritoneum, we wonder not that perforation occurs, but rather at its infrequency. In children, the lesions are not so marked as in adults, and especially is this true as to the depth of the ulcer. Unquestionably this explains the infrequency of perforation in children.

Violent muscular movements and distention of the bowel may increase the danger of perforation. Perforation is more likely to occur in cases with diarrhœa, as shown from the statistics of Johns Hopkins Hospital. Of 30 cases of perforation, 20 had diarrhœa, 16 at the time of perforation. This point becomes more forcible, however, when it is known that of 829 cases, only 19 per cent had diarrhœa during the course of the disease. The time of the perforation coincides with the enfoliation of the slough, as is demonstrated by the large percentage of cases occurring at the end of the second and during the third week.

Mechanical factors, as meteorism especially if of sudden formation, solid contents, forced movements as vomiting, dietetic errors causing increased peristalsis are important.

Perforation is more likely to occur between the ages of 18 and 40, while after 40 it is relatively infrequent.

SHEPPARD'S CASES

Case	Pain	Pulse Rate	Temperature	Leucocyte Count	Blood-Pressure	Peritonitis	Vomiting	Collapse
1	Slight	120 to 170 4½ hours, followed by fall 130	100.2 to 104; in 3 hours later fall	5945 after 30 hours	88 to 116 2 hours Fall to 90	Slight	No	No
2	Yes	120 to 150 2 hours	100 to 102 2 hours	3600 to 11000 in 2 hours	94 to 110 in 2 hours	Decided	No	Yes
3	Slight	94 No change	101.2 to 104 in 7 hours; Fall 98.2 12 hours	8800 maximum	120 no change	Late	Yes	No
4	Yes	128 to 160 Running	98 97	Previous 11600	Impossible to estimate	Yes	No	Extreme
5	Slight	116 to 150 2 hours	101.2 no change	4800 maximum	92 no change	Slight	No	Late

Perforation is more frequent in men than women, which is explained perhaps partly by man's mode of living, the late observation of many cases, and their impatience during convalescence.

The fact must be borne in mind that perforation may take place at any period of the disease, and every patient should be carefully guarded.

SYMPTOMS

This grave complication occurs suddenly and very frequently unexpectedly; however, it may be preceded by increased abdominal distention, colicky pain, borborygmus, diarrhœa, or hæmorrhage may be the warning sign. Six cases of hæmorrhage preceded 30 cases of perforation at Johns Hopkins Hospital.

At the time of perforation the patient (if mentally alert) is seized with a severe pain of rapid progressing intensity, greatly increased by respiration, passive or active motion, and usually on palpation the greatest point of tenderness will be found in the region of the ileocæcal valve.

Pain in typhoid fever was studied by McCrea in 500 cases at Johns Hopkins Hospital. He found that about 40 per cent of the cases are free from both pain and tenderness, and rather less than 20 per cent have tenderness. It was most constantly present with perforation, usually sudden in onset, severe in character and, paroxysmal in occurrence.

Associated with pain are retching and vomiting, the abdomen becomes progressively distended, the walls become smooth and glistening, respiration thoracic, and the paresis of the muscular layer of the intestine attains a high degree. The vomiting may become fæcal in character and even suggest obstruction or ileus. The features assume a hypocratic expression, the nose pinched, the extremities cold, and the face and body covered with a cold clammy perspiration. The pulse increases in rate, becomes quite compressible, and ofttimes thready.

The blood-pressure was carefully studied by Crile and Sheppard. Crile found the highest systolic pressure in uncomplicated cases and with normal arteries as measured by a Riva Rocci sphygmomanometer, in 115 cases of typhoid fever, 138 mm. and the lowest 74 mm. The mean during the first week was 115, second week 106, third week 102, fourth week 96, and the fifth week 98 mm. The mean pressure of all the typhoid was 104 mm. In 20 cases of acute peritonitis, recorded by the same observer, with the same instrument, and otherwise similar cases, the highest was 208 mm. and the lowest 156, the mean 166 mm.

In 5 cases diagnosed as typhoid perforation in which pressure determinations were made (4 of these verified by operation or autopsy, one case not operated on), the pressure rose from 116 to 190 mm. during a period

of four hours. The second case, a lad of 12 years admitted with general peritonitis, pressure 105. Widal positive, immediate operation, later abdominal symptoms of peritonitis disappeared and the pressure fell to 80 mm. On the eighth day infection passed through the wall and peritonitis developed, the pressure again rising promptly from 84 to 110. In the third case, a slow perforation, the pressure rose from 116 to 165 in two hours. The fourth case, a physician, entered the hospital, with general peritonitis, and blood-pressure 165. No operation was performed. Autopsy disclosed perforation. Previous pressure unknown. A fifth case, typhoid, had pressure of 208. At operation, perforation and diffuse peritonitis were found.

Sheppard's observation of 41 cases of typhoid fever near and during the fourth week, showed an average of 98 mm. The cases tabulated above, showing the various symptoms were reported by him and from them he deduced the following conclusions.

The pulse rate rises in almost all cases.

The blood-pressure rises in most cases, but may be difficult to obtain owing to extreme restlessness. Hæmorrhage occurring simultaneously may greatly alter the blood-pressure. Signs are most marked two hours after perforation and the blood-pressure falls to the original level as rapidly as it rises. Sheppard also made blood-pressure observations in the presence of distention, pain, increased leucocytosis, and pulse rate, and found no change except in one case of bronchitis. His final deduction is that a sudden rise in blood-pressure is positive evidence of perforation, while an unchanged pressure is not of negative value.

In the majority of cases there is an immediate elevation of temperature, which in a very few hours is followed by a rapid fall. Rigidity and muscular spasms are not usually present to a marked degree immediately after rupture. Chill is rather a common symptom and is often followed by a cold perspiration. Leucocytosis is a very important symptom, but to be of the highest value the blood-picture must be studied frequently during the course of the disease.

Considerable importance has been given to the disappearance of liver dulness as a symptom of perforation by some writers, while others discredit it by stating it to be comparatively rare.

The Widal reaction should be taken repeatedly in all suspicious cases of typhoid, and will be of the utmost value if previously positive in a suspected case of perforation.

Hiccough, if present, is an important symptom because of its infrequency during the normal course of the disease, and every patient should be examined also for the presence of the free fluid in abdominal cavity, as a variable quantity may be present from the escape of liquid contents.

DIAGNOSIS

In arriving at a diagnosis, a definite distinction should be made between the symptoms of immediate perforation, and those due to the peritonitis resulting therefrom. Unless this all-important distinction is thoroughly recognized, we have deprived our patient of his chances of recovery. The attending physician must ever be on the alert in every case or suspicious case of typhoid to accomplish this distinction, and the nurse or house physician in charge should be instructed to notify him immediately of any change in the symptomatology or condition of the patient. To be able to arrive at the proper conclusion, one must especially have a clear clinical picture of the following conditions before him: acute appendicitis, hæmorrhage, ileus, acute intestinal obstruction, acute pelvic infections, acute cholecystitis, or cholelithiasis.

The diagnosis of acute appendicitis in most cases is comparatively easy. Too much stress cannot be emphasized in taking the history of every case offering difficulty in diagnosis; when properly elicited, if the patient be of moderate intelligence, much valuable information can be obtained that will assist us in arriving at a proper conclusion. The pain of appendicitis not infrequently beginning in the epigastrium radiating over the entire abdomen, greatly relieved for a time after the stomach has been emptied of its contents by vomiting, followed by localized tenderness and rigidity over Burney's point;

absence of a Widal, and with comparatively little disturbance of the pulse and temperature curve, minus shock, will rule out appendicitis.

Of 717 cases treated at the Montreal General Hospital, hæmorrhage occurred in 10 per cent. In hæmorrhage, if severe, the pulse becomes rapid and compressible, the blood-pressure falls, the skin acquires a waxy pallor, there is lividity and coldness of the limbs, the temperature is subnormal, and little or no pain. This presents a clinical picture that cannot be misconstrued.

In ileus or intestinal obstruction, we not infrequently have a history of an inflammatory condition, the presence of possibly strangulated hernia, or of a previous operation.

The first symptom to appear is a severe griping pain more or less localized, paroxysmal in character. The peristaltic wave can frequently be seen ending abruptly and, if obstruction is incomplete, fluids and flatus may be forced through with a gurgling sound, or if complete, obstinate constipation, nausea, and vomiting are early and distressing symptoms. At first the normal stomach contents are ejected, but soon this is followed by bile, dark fluids, and later, intestinal contents with fæcal odor. The abdomen, at first flaccid, soon becomes tympanitic, the pulse increases rapidly, becomes more or less thready, the temperature may be subnormal and the patient presents the general picture of collapse; however, the symptoms as a whole develop less rapidly than do those of perforation.

The pain of pelvic lesions is usually more continuous, but not so severe except, perhaps, that of extra-uterine pregnancy. Vomiting is not frequent in these conditions. The not infrequent bilateral condition, the tenderness and rigidity obtained by double palpation, the presence ofttimes of a mass in the pelvis associated with tenderness and rigidity of the vaginal vault, will easily rule out pelvic lesions of an inflammatory character, while if we suspect extra-uterine pregnancy, the early signs of pregnancy, collapse, associated with subnormal temperature, absence of leucocytosis, the presence of uterine hæmorrhage and a fluctuating mass in the tubo-ovarian region will be valuable aids.

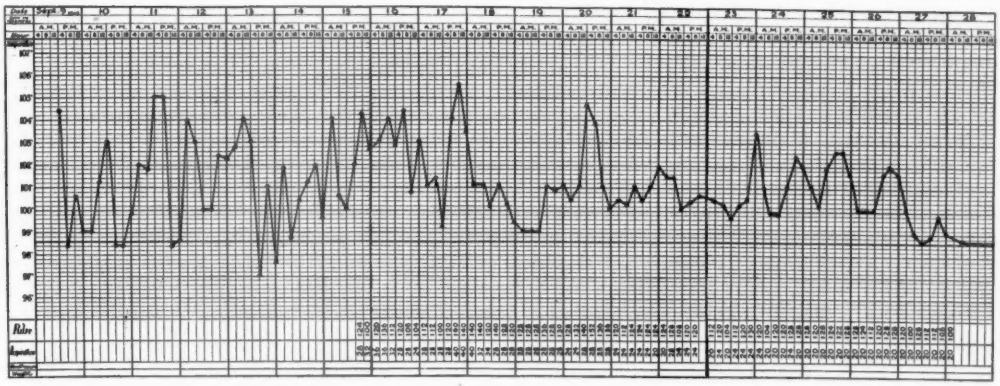
The not uncommon association of gall-bladder infections and typhoid fever calls for special consideration. A study of the literature shows that perforation is rather infrequent after 40 years of age, while on the other hand, gall-bladder infections are relatively infrequent before. It is more common in females than males and especially in those who have borne children. The attack is frequently associated with indiscretion in diet, coming on suddenly with severe paroxysmal pain in the epigastrium and right hypochondric regions. Repeated vomiting is the rule and the contents are usually richly bile stained. The abdomen is distended and rigid, but the greatest point of tenderness is usually at the costal margin. The temperature rises while the pulse is comparatively slow, which is an extremely important diagnostic point. A study of the literature demonstrates that perforation of the gall-bladder in typhoid fever does occur and issues a warning sign to be on our guard.

Finally, if our cases are studied carefully and the conditions that are likely to cause confusion kept closely in mind, few mistakes will be made, and many lives saved.

TREATMENT

There is only one method of treatment in these cases requiring discussion, which was well stated by Mikulicz in 1884, when he said: "If suspicious of perforation one should not wait for an exact diagnosis and for peritonitis to reach a profound degree, but, on the contrary, one should immediately proceed to an exploratory operation which in any case is free from danger." How much more true the above statement is in present day surgery, is well understood. Our patient's life depends on the recognition of the perforation, and not the resulting peritonitis, and unless we are capable of doing this we are a stumbling block to the patient's welfare.

As soon as perforation is recognized, or greatly suspected, the patient should be given morphine immediately. Quoting Morris: "We are choosing the lesser of two evils, for the tremendous shock is more deadly than are the escaping bacteria when the patient is not quieted by opium."



Temperature chart. Case C. H. Note sudden rise of pulse and temperature on the 17th at time of perforation.

There seems to be a difference of opinion as to the choice of anæsthesia. Woolsey believes these cases take gas and ether well. In two cases reported by him, cocaine was used satisfactorily for exploration, but retraction of the edges and the necessary handling of the inflamed bowel were painful, and this, together with the realization of being subjected to an operation, cause more shock than general anæsthesia.

As to choice of incision, most surgeons will agree on the right rectus, or McBurney's as statistics conclusively show that more than 80 per cent of the cases perforate in the lower eighteen inches of the ileum, and the nearer we are to the lateral wall, the less the danger of spreading the infection over the peritoneal cavity. The perforation should be located as quickly as possible and with little handling of the bowel.

The perforation can be closed in most cases with a purse-string reinforced with a row of Lembert or mattress sutures; the greatest care being taken, however, not to constrict the lumen of the bowel, which, if done, will almost certainly result in ileus. In all cases the ileum should be explored as far as the inflammatory process extends, for multiple perforations or deep ulcers. Some cases may require resection where the perforation is large, but unfortunately the quickly resulting peritonitis and extreme shock of such an extensive procedure has proved fatal in nearly all reported cases of this character.

The peritoneal cavity should be carefully sponged with saline solution, but irrigation should be avoided unless a general peritonitis exists. Thorough drainage should be employed and the Fowler position obtained as soon as the patient's condition will permit.

Intravenous, subcutaneous or proctoclysis, should be used according to the demands of the condition of the patient. Morphine should be continued until the peritonitis becomes well localized and the bowel not disturbed in any way. Later they should be taken care of by flushing and small doses of eserine. No food whatever should be given by mouth, and if vomiting has been quite severe, lavage should be used before the patient comes from under the anæsthetic. Stimulation should be used according to the demands of the patient and the condition of the heart muscle carefully observed.

In conjunction with this paper, I wish to present the following case:

C. H., age 7. *Previous history.* Child showed some malnutrition during first year but rapidly outgrew it. Had measles about two years ago and a few months later chicken pox and mumps, all of which were mild in character and left no sequelæ; otherwise has been exceptionally well.

Present illness. On August 28, 1914 after returning from a ride, he complained of headache, and the next few days seemed to have a cold which did not yield to the usual home remedies. He appeared languid and drowsy. Dr. J. M. Nicholson was called to see him September 9 and after a careful examination, a diagnosis of bowel infection was made. The bowel movements were rather watery

and decidedly green in color. The patient had a variation of temperature from 98° to 104.8°. The following day the temperature varied from 96° to 103° and on the 11th 98.4 to 105° with a continuation of the green movements.

No improvement was shown during the next few days and I was called in consultation the evening of the 15th. A careful examination was negative other than abdominal trouble. Much distention was present, but no special tenderness, and the bowel movements were decidedly green. Until this time the child had been cared for by the mother. A nurse was put in charge of the patient and a Widal suggested if improvement did not occur immediately.

On the 16th there was little change. The 17th, at 10:30 a.m., temperature 99.8°, pulse 100, respiration 28; 4:30 p.m., temperature 104°, pulse 120, respiration 28, and at 6 p.m. temperature 102.8°, pulse 120, respiration 28. All movements of the day were recorded as very green and the result of normal saline flushings. 7:30 p.m., the child had a severe chill lasting 10 minutes which was followed by a very severe pain in the right side. The pulse became weak and the lips and fingers cyanotic. The grave condition of the patient was recognized immediately by the nurse and Dr. Nicholson was called. An immediate blood examination was made by Dr. Nicholson showing a leucocytosis of 32,000; and the patient was ordered to St. Joseph's Hospital. The temperature at 8:15 p.m. was 105.6°, pulse 160, respiration 40; 9:00 p.m., temperature 105°, pulse 160, respiration 40; 9:45 p.m., temperature 103.4°, pulse 140, respiration 40. The patient entered the operating room at 11:30 p.m. with the typical expression of collapse and peritonitis. I was assisted by Dr. Nicholson, to whom I wish to give due credit for his alertness. A McBurney incision was made and the following conditions discovered:

1. A very severe appendicitis; appendectomy.

2. A perforation about 16 inches from the ileocæcal valve which was rapidly closed, and two other ulcers that showed clearly through the peritoneal coat were reinforced. The abdominal cavity was carefully sponged with normal saline solution and a small median incision was made for counter drainage. The patient was returned to his room at 12:30 a.m.

At 1:30 a.m. pulse 160, respiration 40. Stimulants and morphine were given. At 7:00 a.m. axilla temperature 100°, pulse 140, respiration 32; 10:00 a.m., temperature 100°, pulse 120—stronger; respiration 34. Digitalin 1-200 was given every 4 hours. 6:00 p.m., temperature 101°, pulse 140; respiration, 28; 12:00 m., temperature, 99.6°; pulse, 120; respiration, 28—but very restless. September 19, temperature varied 99 to 101°, pulse, 120 to 136, very weak. September 20, temperature varied 101° to 104.6°, pulse 128 to 152. Abdomen greatly distended with marked intestinal paresis.

Eserine gr. 1-200 given at 9 p.m. and 3 a.m. with calomel gr. 1-20 every hour. 7:00 a.m. watery bowel movement and much gas. September 21, temperature 100° to 101°, pulse 128 to 136, respiration 24 to 28. Eserine 4, 10 and 4 involuntary bowel movement. 2:30 p.m. and semicolid bowel movement at 8:30 p.m. Positive Widal obtained. September 22, temperature 100° to 102°, pulse 108 to 128, respiration 20 to 24. Fairly good night; eserine at 8, 2, and 8. September 23, temperature 99.6 to 103.4°, pulse, 100 to 132. September 24, temperature 99.8 to 102.6°, pulse, 104 to 128. Sept. 25, temperature 100.2 to 102.6°, pulse, 120 to 128. September 26, temperature 99.4 to 102°, pulse 112 to 128. September 27, temperature 98.6 to 100°, pulse 100 to 128. September 28, temperature 98 to 98.6°, pulse 108–112. September 29 and 30, temperature 97 to 98.6°, pulse 96 to 108. October 1, temperature rectal, 96.2 to 97°, pulse 80 to 100, very irregular; acute myocarditis present. October 3, rectal temperature 96.4 to 97.4°, pulse 64 to 88 very irregular. Patient cold, external heat applied. Pulse remained very irregular during the next week after which time recovery was uneventful.

In conclusion, the following deductions may be drawn:

1. While perforation varies greatly in different epidemics, about 12 per cent of the total death-rate is due to this complication.

2. That perforation occurs in about 3 per cent of all cases treated.

3. That perforation is relatively infrequent in children.

4. Statistics show that over 80 per cent of the total perforations occur in the lower ileum.

5. That the location of perforation coincides with the study of Baer.

6. That the majority of cases perforate during the second and third week.

7. Diarrhœa is an important factor in its production.

8. Acute abdominal pain during the course of typhoid should always be taken seriously.

9. The sudden rise of blood-pressure is positive evidence of perforation, while an unchanged pressure is not of negative value.

10. The importance of a careful study of the blood cannot be overestimated.

11. The welfare of the patient depends on our ability to differentiate between the symptoms of perforation and those of the resulting peritonitis.

12. The treatment of perforation is surgical, and the death-rate is in inverse ratio to the length of time allowed to elapse before operation.

13. Opiates are indicated as soon as perforation has taken place and should be continued until the peritonitis has become well localized.

BIBLIOGRAPHY

For cases of perforation reported previous to 1898 see Keen's Surgical Complications and Sequels to Typhoid Fever, 1898. For cases reported between 1898 and 1900, see Keen, J. Am. M. Ass., 1900, xxxiv, 130.

ABBE. Med. News, N. Y., 1902, lxxx, 582.
ACHARD. Bull. et mém. Soc. med. d. hôp. de Par., 1912, xxxiv, 729.
ACMEA. Arch. Latino Am. de pediat., Buenos Aires, 1912, v, 402.
ALDER. Gyermekorvos Budapest, 1905 and 1906.
ALLABEN. J. Am. M. Ass., 1907, xlix, 554.
ALLEN. Nort. of Eng. M. & S. J., Lond., 1904, lvii, 904.
ARDIN DELTEIL. Bull. med. de Alger, 1908, xix, 287; ibid, xx, 64.
ARMOUR. West Lond. M. J., 1907, xii, 109.
ARMSTRONG. Brit. M. J., 1910, ii, 1298.
IDEM. Lancet, Lond., 1914, ii, 307.
AZEMA. Toulouse-med., 1905, vii, 265.
BABLER. Quart. Bull. M. Dept. Washington Univ., St. Louis, 1904, iii, 121.
BAGLEY. Surg., Gynec. & Obst., 1910, xi, 367.
BAKER. Lancet, Lond., 1901, i, 660.
BARRS and THOMPSON. Brit M. J., 11904, i, 194.
BASILE. Policlinic, Rome, 1905, xii, 157.
IDEM. Boll. d. Soc. Lancisiana d. osp. de Roma, 1905, xxv, 25.
BERG. Med. Rec., N. Y., 1901, lix, 441.
BLACKWOOD. Clinique, Chicago, 1903, xxiv, 513.
BLAKE. Ann. Surg., Phila., 1903, xxxvii, 283.
IDEM. N. Y. M. J., 1907, lxxxv, 337.
IDEM. Ann. Surg., Phila., 1906, xliii, 933.
BLEDSOE. J. Am. M. Ass., 1910, lv, 999.
BLUMER. Yale M. J., 1908, xv, 477.
BOYLOC. Toulouse-med., 1905, vii, 211.
BRETUN. St. Petersb. med. Wchnschr., 1907, xxxii, 379.
BRIDGES. Med. Herald, St. Joseph, xxii, 489.
BRIGGS. Am. J. M. Sc., 1903, cxxv, 821.
IDEM. Boston M. & S. J., 1903, cxlix, 343.
BRISTOW. St. Louis M. Rev., 1904, i, 337.
BROWN. St. Louis M. Rev., 1905, li, 44.
IDEM. J. Am. M. Ass., 1909, lii, 695.
BRUCE. Indian M. Rec., Calcutta, 1902, xxii, 711.
BUTKEVICH. Khirurgia Mosk., 1909, xxvi, 86.
CASTAGNARY. Gaz. med. de Nantes, 1905, xxiii, 753.
CHANDLER. J. M. Soc. N. J., 1904, i, 143.
CHANTEMESSE. Bull. et mém. Soc. de chir., de Par., 1908, xxxiv, 578.
CHARPENAY. Loire méd., St.-Etienne, 1907, xxvi, 295.
CLOPTON. J. Mo. M. Ass., 1913, x, 399.
COBB. Boston M. & S. J., 1907, clvii, 78.
COCHOIS. Arch. de med. et pharm. mil., Par., 1909, liii, 411.
COLE. J. Am. M. Ass., 1913, lx, 122.
COTTON. Boston M. & S. J., 1906, clv, 151.
COURTNEY. J. Am. M. Ass., 1905 xlv, 1714.
CRAIG. Australia M. Gaz. 1909, xxviii, 313.
CRESPIN. Brazil Med., Rio de Jan., 1906, xx, 463.
CRILE. J. Am. M. Ass., 1903, xl, 1292.
DAHIGREN. Upsala Laekaref. Foerh., 1902, viii, 543.
DANDRIDGE. Lancet-Clin., 1905, liv, 611.
DANIELL. Lancet, Lond., 1906, i, 1043.
DAVIS. Am. J. Obst., N. Y., 1908, lviii, 982.
IDEM. J. Am. M. Ass., 1904, xlii, 1329.
DELATOUR. Am. J Surg., N. Y., 1910, xxiv, 41.
DEL VALLE. Semana méd., Buenos Aires, 1912, xix, 1101.
DEVIC. Rev. de méd., Par., 1905, xxv, 694.
DOS SANTOS. Med. contemp., Lisb., 1912, xxx, 81.
DOUGLAS. Nashville J. M. & S., 1902, xci, 55.
DRURY. Med. Press. & Circ., 1904, lxxvii, 29.
DU BOIS. Am. J. Surg., N. Y., 1910, xxiv, 187.
DUBUJADOUX. Arch. de méd. et pharm. mil., Par., 1908, li, 324.
DUNN. Northwest. Lancet, 1904, xxiv, 167.
DUVERGEY. Gaz. heb. de sc. méd. de Bordeaux, 1908, xix, 193.
DUVOL. Paris, 1911, p. 80.
IDEM. Bull. et mém. Soc. de chir., de Par., 1911, xxxvii, 984.
ELLIOTT. Hahnemann Month., Phila., 1907, xlii, 881.
ERDMANN. Ann. Surg., Phila., 1903, xxxvii, 878.
FAISANS. Bull et mém. Soc. d. hôp. de Paris, 1908, xxv, 900.
FAVREUL. Gaz. méd. de Nantes, 1912, xxx, 212, 501.
FISHER. Indian Med. Gaz., Calcutta, 1913, xlviii, 106.
FLAMINI. Riv. de chir. pediat, Firenze, 1905, iii, 520.
FLOEKEN. Stuesbuy 1911 Elsass. Lothr. Druck, p. 36.
FOLKES. South. M. J., 1911, iv, 527.
FONTOYNONT. Bull. et mém. de Soc. chir., Paris, 1908 xxxiv, 701.
FOSTER. Ohio M. J., 1911, vii, 382.
FRANK. J. Am. M. Ass., 1904, xlii, 878.
FULTON. Am. Med., Phila., 1904, vii, 699.
GANJOUX. Montpelier méd., 1909, xxix, 35.
GAUTHIER. Bull. méd. de Algers, 1902, xiii, 106.
GERVIN. South M. J., 1914, vii, 811.
GIVE. Internaz d. soc. méd., Napoli, 1908, xxx, 395.
GLAZEBROOKE. Virginia M. Semi-Month., 1907, xii, 498.
GOODALL. Lancet, Lond, 1904, ii, 9.
GRAESSLE. J. Ind. M. Ass., 1912, v, 160.
GREAVES. Brit. M. J., 1906, i, 373.
GREEN. Toledo M. & S. Reports, 1907, xxxiii, 65.
GRIFFITH. Am. J. M. Sc., 1905, cxxx, 581.
GROSS. Rev. méd. de lést, Nancy, 1908, xl, 437.
GROVES. Austral. M. J., Melbourne, 1911, i, 299.
GUERRIERI. Gazz. Internaz. de méd., Napoli, 1910, xii, 736.
HAGGARD. South. M. J., 1909, ii, 884.
HAMILTON. Montreal M. J., 1901, xxx, 93.
HARE. Wis. M. J., 1903, i, 340.
HARTE. Ann. Surg., Phila., 1904, xxxix, 8.
IDEM. Cleveland M. J., 1905, iv, 125.
IDEM. Boston M. & S. J., 1907, clvii, 69.
HAWKES. Med. Rev., N. Y., 1907, lxxi, 414.
IDEM. Med. & Surg. Reports. Presbyterian Hosp., N. Y., 1912, ix, 481.
HAYS. J. Am. M. Ass., 1905, xliv, 1265.
IDEM. Penn. M. J., 1907, xi, 255.
HEAD. J. Minn. M. Ass., 1911, xxxi, 353.
HERMES. Deutsche med. Wchnschr., 1910, xxxvi, 1743.
HEUSTON. J. Roy. Army. M. Corp., Lond., 1904, ii, 726.
HERCZEL. Orvosi hetil., Budapest, 1904, xlviii, 400.
IDEM. J. Am. M. Ass., 1905, xlv, 1313.
HOLMES. Wis. M. J., 1904, iii, 375.
IDEM. J. Am. M. Ass., 1903, xl, 714.
JOPSON. Arch. Pediat., N. Y., 1904, xxi, 195.
IDEM. Am. J. M. Sc., 1909, cxxxviii, 625.
JEWETT. Am. J. Homeop., N. Y., 1911, lix, 320.
KAEHLER. Deutsche med. Wchnschr., 1907, xxxviii, 1370.
KEEN. J. Am. M. Ass., 1900, xxxiv, 130.
IDEM. Chicago: J. B. Hamilton, 1900.
KENERSON. Buffalo M. J., 1901, xl, 638.
KILIANI. Ann. Surg., Phila., 1907, xiv, 34.
IDEM. Ann. Surg., Phila., 1914, lix, 637.
KRILOFF. Khirurg. Arkh. Velyaminova S. Petersb., 1912 xxviii, 524.
KYLE. Bristol M.-Chir. J., 1903, xxi, 30.
LAFFAN. Lancet, Lond., 1909, i, 100.
LAFLEUR. Montreal Med. J., 1901, xxx, 89.
LEYHECKER. Reichs.-Med. Anz., Leipz., 1911, xxxvi, 806.
LLOYD. Proc. Phila. Co. Med., Soc., 1902, xxiii, 434.
LOISON. Bull. et mem. Soc. de chir., Par., 1908, xxxiv, 338.
LONG. Surg., Gynec. & Obst., 1907, iv, 301.
LONGHRAN. Austral. M. Gaz., 1910, xxix, 77.
LOP. Gaz. d. hôp., Paris, 1911, lxxxiv, 1098.
LORD. Med. Chron., Manchester, 1910, liii, 42.
LOVE. Glasgow M. J., 1903, xl, 13.

MACLEAN. Canada Lancet, Toronto, 1903, xxxvii, 1011.
MACKENZIE. Practitioner, Lond., 1904, lxxii, 161.
MALETET, DEANESBY. Brit. M. J., i, 1079.
MANGER. J. de méd. et chir. prat., Par., 1901, lxxii, 369.
MANNINI. Riforma med., Palermo, 1900, iii, 710.
MARTIN. Ann. Surg., Phila., 1908, xlviii, 133.
MATLOCK. Tr. Luzerne Co. M. Soc., Wilkesbarre, 1910, xvii, 89.
MAZZETTI. Riforma med., Napoli, 1908, xxiv, 487.
MCGAVIN. Clin. J. Lond., 1907, xxxi, 249.
MCGUIRE. N. Y. St. J. Med., 1909, ix, 502.
MCOSCAR. Ft. Wayne M. J., Mag., 1905, xxvi, 447.
MCPHREDRAN. Canada Lancet, Toronto, 1906, xi, 577.
MCWILLIAMS. Ann. Surg., Phila., 1912, lv, 437.
MEAKINS. Montreal M. J., 1905, xxxiv, 741.
MENESTRINA. Med. Fortnightly, St. Louis, 1907, xxxii, 378.
MERG. Presse méd., Par., 1902, ii, 759.
MICHAUX. Bull. méd., Par., 1908, xxii, 105.
MICLESEN. Therap. Monatsh., Berl., 1902, xvi, 553.
MILHIT. Progrés. méd., Par., 1908, xxiv, 493.
MITCHELL. Ann. Surg., Phila., 1907, xlv, 470.
IDEM. Lancet, Clin., 1907, xcviii, 87.
IDEM. Penn. M. J., 1907, xi, 252.
IDEM. Brit. M. J., 1913, ii, 724.
MOFFAT. Med. Rec. N. Y., 1907, lxxii, 57.
MONAST. Arch. de méd. et pharm. mil., Par., 1906, xlvi, 129.
MOORHEAD. Brit. M. J., 1907, ii, 1148.
MORESTIN. Bull. et. mém. Soc. chir., Par., 1908, xxxvi, 348.
MORRIS. Med. Times, N. Y., 1913, xli, 365.
MOTY. Gaz. de hôp., Par., 1908, lxxxi, 927.
MOURIQUAND. Lyon méd., 1903, ci, 38.
MUNRO. Boston. M. & S. J., 1903, cxlviii, 146.
MURPHY. J. Am. M. Ass., 1903, xl, 977.
MYLOAGANON. Brit. M. J., 1909, i, 271.
NEWELL. Cal. St. J. Med,. 1908, lxxxi, 927.
NEWLIN. Penn. M. J., 1907, xi, 249.
NICOLO. Riv. Veneta di med., Venezia, 1908, xlix, 365.
OBEYESEKERE. Brit. M. J., 1911, i, 199.
OKINSHEVICH. Med. Obozr., Mosk., 1907, lxvii, 687.
OLMER. Marseilles méd., 1907, xliv, 19.
OSLER. Lancet, Lond., 1901, i, 386.
IDEM. Phila. M. J., 1901, vii, 116.
ORTALI. Riv. méd., Milano, 1913, xxi, 39.
ORTEGA and BELGRANO. Rev. Soc. med. Argen., Buenos Aires, 1905, xiii, 151.
OULMONT. Bull. et mém. Soc. de hôp., Par., 1912, xxxiv, 693.
PARSONS. Dublin J. M. Sc., 1904, cxvii, 108.
PATTERSON. Am. J. M. Sc., 1909, cxxxvii, 669.
PEARSE. Am. J. Surg. & Gynec., St. Louis, 1902, xv, 165.
PELFORD. Arch. Latino-Am. de pediat., Buenos Aires, 1913, vii, 66.
PHILIBERT. Gaz. de hôp., Par., 1910, lxxxiii, 237.
PLOTKIN and POTEL. Echo. méd. du Nord., Lille, 1909, xiii, 157.
PLUYETTE. Marseilles méd., xli, 321.
POLCENIGO. Riv. Veneta de. sc. med., Venezia, 1912, lvi, 420.
PONCET. Lyon méd., 1903, c, 373.
PONCHEL. Marseilles méd., 1908, xlv, 385.
POTTER. Tr. Rhode Island M. Soc., 1902, vi, 466.
IDEM. Providence M. J., 1902, iii, 167.
PRICE. Am. J. Obst., N. Y., 1907, lvi, 691.
QUENU. Rev. gén. clin. et therap., Par., 1909, xxiii, 785.
RAMSEY. Northwest Lancet, 1903, xxiii, 205.
REDER. Interstate M. J., St. Louis, 1904, xi, 667.
REILLY. Montreal M. J., 1909, xxxviii, 129.
RENNIE. Intercolon. M. J. Austral., 1907, xii, 444.
ROBERTS. Ann. Surg., Phila., 1906, xliv, 242.
IDEM. Ann. Surg., Phila., 1909, xlix, 392.
ROCHARD. Gaz. de hôp., Par., 1904, lxxvii, 705.
RODMAN. Penn. M. J., 1902, v, 479.
RONTTE. Arch. de méd. et pharm. mil, Par., 1909 liii, 404.
RONVILLOIS. Bull. et mém. Soc. de chir., Par., 1913, xxxviii, 161.
ROSS. Am. J. M. Sc., N. Y., 1905, cxxx, 115.
ROUXDE and Brignoles. Marseilles méd., 1908, xiv, 1882.
RUSSELL. Montreal M. J., 1903, xxxii, 584.
SCOTT. West Va. M. J., 1909, iv, 197.
IDEM. Internat. Clin., Phila., 1908, iii, 21.
IDEM. N. Y. M. J., 1907, lxxxv, 245.
IDEM. Univ. Penn. M. Bull., Phila., 1905, xviii, 81.
IDEM. St. Barth. Hosp. Rep., Lond., 1903, xxxix, 133.
SCUDDER. Boston M. & Surg. J., 1905, cliii, 84.
IDEM. Boston M. & S. J., 1907, clvii, 76.
SELBY. J. Am. M. Ass., 1907, xlviii, 2108.
SENECHAL. Gaz. méd., Par., 1909, p. 5.
SETBON. Paris, 1902, p. 535.
SHATTUCK. Boston M. & S. J., 1907, clvii, 75.
SHEPPARD. Lancet, Lond., 1907, i, 1293.
SHOEMAKER. Am. Prac. & News,. Louisville, 1906, xl, 467.
SKINNER. Surg. Clin., Chicago. 1902, i, 372.
SMITH. Tr. Roy. Acad. Med., Ireland, 1904, xxii, 23.
SPARKMAN. J. South Car. M. Ass. 1912, viii, 294.
SPOLM. Tex. St. J. Med., 1905, i, 338.
SOPER. St. Louis Courier Med., 1906, xxxix, 139.
St. VINCENT DE PARONF. Arch. de méd., et pharm. mil., Par., 1908, lii, 51.
STEVENS. Ky. M. J., 1910, viii, 1587.
STRICKLER. J. South. M. Ass., 1909, xiv, 61.
TAKEZAKI. Gun Igaku Kwai Zasshi, Tokyo, 1904, p. 281.
TAYLOR. Dublin J. M. Sc., 1901, cxi, 1.
IDEM. N. Y. M. J., 1902, lxxv, 193.
IDEM. Nashville Med. J., 1902, xci, 68.
IDEM. Virginia Hosp. Bull., 1904, i, 3.
IDEM. Mobile M. & S. J., 1904, p. 249.
TENNANT. Virginia Semi Month., 1909, xiv, 61.
THORNTON and GODWIN. Lancet, Lond., 1901, ii, 442.
TONSSAINT. Bull. et mém. Soc. de chir., Par., 1906, xxxii, 513.
TROITSKI. Bolnitsch gaz. Botkina, St. Petersb., 1903, xiv, 49.
TURNER. Guy's Hosp. Gaz., 1909, xxiii, 413.
IBID. 1913, xxvii, 400.
VERON and BUSQUET. Rev. de méd., Par., 1902, xxii, 366.
VINA and ALMAZAN. Crón. méd.-quir., Habana, 1909, xxxv, 429.
VOORSANGER. Am. Med., 1903, vi, 318.
WARFIELD. Interst. M. J., 1910, xvii, 920.
WATSON. Clin. J., Lond., 1908, xxxiii, 283.
IDEM. St. Barthol. Hosp. Reports, Lond., 1909, xlv, 131.
WEAVER. South M. J., 1908, i, 395.
IDEM. J. Ind. M. Ass., 1914, vii, 146.
WESSINGER. Physician & Surg., 1905, xxvii, 501.
WHITING. Tr. Phila. Acad. Surg., 1911, xiii, 32.
WHITNEY. Ann. Surg., Phila., 1910, li, 697.
WILLIS. Old Dominion J. M. & S., 1914, xviii, 193.
WILSON. Phila. M. J., 1903, xi, 748.
IDEM. Alabama M. J., 1904, xvii, 13.
IDEM. Mobile M. & S. J., vii, 172.
IDEM. N. ORLEANS S. & M. J., 1908, xli, 623.
IDEM. Phila. Hosp. Rep., vii, 229.
WOOLSEY. Ann. Surg., Phila., 1906, xliii, 652.
IDEM. Ann. Surg., Phila., 1906, xliii, 439.
WRIGHT. Therap. Gaz., Detroit, 1905, xxi, 368.

DELIVERY BY ABDOMINAL SECTION[1]

By EDWARD P. DAVIS, M.D., F.A.C.S., Philadelphia

NOTHING has been more striking in the evolution of medical science than the advance which has taken place in a comparatively brief time in obstetric surgery. The establishment of cæsarean section upon a basis of success comparable with that of other abdominal operations was a great advance over the uncertain and unsatisfactory and difficult deliveries by forceps or craniotomy. But recently it was found that, in addition to the problem of delivering the child safely, a very considerable range of pathological conditions accompanying pregnancy may be successfully dealt with at the time of delivery. The fact that it is difficult and often impossible to positively know the condition of pelvic and abdominal organs without section and that during labor serious changes may occur in intra-abdominal conditions, which may result in infection or hæmorrhage, has made delivery by abdominal section in many instances a far more complicated procedure than simple cæsarean section.

Highly contracted pelvis has been made one of the simplest complications of parturition by the success of a classic cæsarean section, but pathological conditions in the pelvis and abdomen complicating pregnancy may be of several varieties.

The most serious accident in labor or in pregnancy is rupture of the uterus and, whether this occurs during parturition or during pregnancy, the most successful treatment is by abdominal section. Rarely is it possible to save the uterus. Hysterectomy in the great majority of cases is indicated and, if it is thought wise to drain through the vagina, extirpation of the uterus may be chosen.

Foci of infection in pelvic or abdominal organs developing during pregnancy may threaten the patient's life through the bursting of an abscess and the escape of its contents into the peritoneal cavity. One of the difficulties in diagnosis in such a case is the fact that such a focus may remain quiescent during the greater part of pregnancy and its existence only become apparent through some accident. In the experience of the writer, a woman of unknown antecedents passed easily through a spontaneous labor and a puerperal period of two weeks without evident complications. During the third week while convalescent and acting as helper in a ward, after lifting a bucket of coal, she complained of vague indefinite abdominal pain. Influenza was epidemic at the time and many of her symptoms were those of influenza. Peritonitis rapidly developed and section, undertaken too late, revealed an old focus of infection in a tubal abscess which had ruptured upon exertion, causing fatal infection. Could the existence of this abscess have been known at the beginning of labor and abdominal section promptly performed, the patient's life might have been saved. It would have been wiser in that case to have delivered the child by section without labor and then dealt with the abscess.

A not uncommon and very great risk to the parturient woman is appendicitis. If this condition is not met promptly by operation and abscess forms, the uterus will usually undergo contraction and abortion or labor develop. In either event, the contractions of the uterus will rupture the wall of the appendiceal abscess and infection will follow. The majority of obstetricians remove the diseased appendix at whatever period of pregnancy appendicitis may develop and with excellent results. Should appendiceal abscess complicate gestation and viability, it would be safer to open the abdomen, empty and close the uterus, and then deal with the appendiceal condition.

Obstetricians have learned by experience that it is dangerous for a woman having a septic focus in pelvis or abdomen to undergo the disturbance of labor, and there is no method combining prompt delivery and efficient

[1] Read before the Medical and Chirurgical Faculty of Maryland, Baltimore, April 25, 1916.

treatment of the septic condition present which compares with abdominal section.

The presence of pelvic or abdominal tumors complicating pregnancy is also an indication for section. Ovarian tumors during pregnancy have an especial tendency to twisting of the pedicle and the gangrenous changes in the tumor which follow this accident. Fibroid tumors which block the pelvis or seriously interfere with the contraction of the uterine muscle furnish a valid indication for section. Multiple fibroids of the uterine muscle which may produce no tumor large enough to be detected by palpation prevent the physiological development of labor and are best dealt with by delivery by section. Cancer of the cervix calls for the prompt extirpation of the uterus so soon as discovered, but if the patient be near viability and wishes to take the risk of the prolongation of pregnancy to secure a living child, delay may be practiced in accordance with the patient's request.

The topic receiving most attention at present from obstetricians throughout the principal clinics in this country and abroad is the treatment of advanced pregnancy complicated by premature separation of the placenta, whether normally situated or placenta prævia. This topic was discussed at several international meetings just before the European War and, in the literature of the year 1915, the number of papers upon this subject far exceeds those written upon any other topic. Obstetricians recognize fully the fact that many of these cases must be dealt with by the general practitioner in emergency. Certain well-defined procedures are available under these circumstances. But as hospital facilities are becoming more abundant in this country and means of transportation more efficient, more of these cases will receive hospital care. Under these circumstances, there can be no question but that premature separation of the normally implanted placenta is dealt with most promptly and safely by section.

Obstetric opinion may be divided as to the choice between vaginal and abdominal section, but the writer's preference is decidedly for the latter. There is a much wider difference of opinion concerning the treatment of placenta prævia by abdominal section. Many obstetricians limit the operation to those cases where the cervix is undilated and not readily dilatable and where mother and child are in good condition, the child's heart sounds being sufficiently strong to indicate that it has not suffered greatly from the loss of maternal blood.

In the mind of the writer, placenta prævia is analogous with ectopic gestation. By ectopic gestation, as commonly understood, we mean the attachment of the ovum outside the cavity of the uterus, and the common acceptation of this term limits this attachment to the wall of the uterus and the contents of the pelvis or abdomen. Under these circumstances, the danger of infection, aside from that which accompanies an operation, is very little and arises from the proximity of the ectopic gestation to the intestine and its contents of fæces and bacteria. The great risk of ectopic gestation is ordinarily hæmorrhage.

When placenta prævia is considered, the ovum at all stages of pregnancy is attached very near the vagina, which invariably contains bacteria. Dilatation of the cervix to some slight extent is inevitable and this is at once accompanied by the danger of infection. This danger is now appreciated and the majority of obstetricians have abandoned in placenta prævia tamponing the vagina or other forms of treatment through the vagina, except such as have for their object the emptying of the uterus by the removal of its contents. In placenta prævia the lower portion of the uterus is unusually rich in blood and the separation of the placenta opens many channels for infection. Post-partum hæmorrhage is a frequent accompaniment of vaginal delivery in placenta prævia.

Under these circumstances, in cases where the greater portion of the cervix is covered by placenta and the membranes are not readily available for rupture, it is the writer's belief that delivery by abdominal section is indicated.

Modern surgery has reiterated anew the doctrine of the importance of shock. In all

departments of surgery the effort is constantly made to improve anæsthesia and to block those channels by which dangerous reflexes may be conveyed to vital centers. Obstetricians recognize the fact that there are patients in whom the physiological phenomena of spontaneous parturition cannot be successfully carried out and in whom the occurrence of uterine contraction and dilatation end in failure to deliver the child and in dangerous depression. The phrase "physiological incompetence" for labor has been proposed by some who have written upon this subject. Under these conditions, anæsthesia and delivery by abdominal section at a most favorable time and under the most favorable circumstances give better results than a painful and tedious labor followed by difficult vaginal delivery and its inevitable traumatism.

The present world crisis has considerably increased the value of human life through the enormous waste which war has occasioned. Hence the preservation of infant life is at present a topic of widespread interest. While the ancient rule holds that the mother's interests should first be considered, cases arise in which the mother's interests are not unduly jeopardized if the birth of the child be secured by abdominal delivery. Patients who have lost children in previous labors through disproportion or physiological incompetence, although the pelvis may be of average size, may rightfully elect delivery by section in the interest of the child. Were the mother only to be considered, craniotomy might be employed in the failure of spontaneous labor.

Very rarely conditions arise where prompt delivery under anæsthesia is indicated in the interests of mother and child because some condition of visceral disease threatens the lives of both. In the writer's experience, delivery by abdominal section in eclampsia is very rarely indicated and yet occasionally, where the mother has apparently been in good condition before the first convulsion and where the child's heart beats are strong and regular and no sign of labor develops, immediate delivery by section may be admitted. In cases of serious disease of the heart, where the child is abundantly viable and compensation is failing, it may be possible to save the life of the child and prolong that of the mother by delivery by section without labor.

Under what conditions shall delivery by abdominal section be terminated with the sterilization of the mother? A plain indication arises where there is abundant evidence that the uterus is the site of an active septic infection at the time of labor. In these cases a cardinal rule of operation calls for the removal of the fallopian tubes and body of the uterus and the leaving of the uterine stump outside the peritoneal cavity or, if the operator prefers, the extirpation of the entire uterus. The removal of the ovaries or their preservation must depend upon the age of the patient and the condition of the pelvic tissues at the time of operation.

Shall the obstetrician act as judge in those unfortunate women who are habitually immoral, diseased, and mentally, physically, and morally degenerate? And shall the procreative power of such be terminated by operation? In these cases, the cardinal rule of the profession is to save life without regard to the moral character of the individual, but in those women who are imbecile, epileptic, insane or degenerate the permission of parent or guardian should be obtained for sterilization. If such is not available, consultation should certainly determine the propriety of the step.

Have husband and wife the right to decide that sterilization be performed?

This question may be a difficult one to decide but, in the experience of the writer, such a request will rarely be made of the obstetrician, unless there is the history of previous unsuccessful and dangerous parturition. Such is the success of repeated section that this choice should not be hastily made and, if the parents are sound and there is every reason to believe that the offspring are healthy, the claims of repeated section must be urged. But if the parents decline to take the risk of repeated section and request sterilization, it is a question whether the obstetrician has a right to refuse such a request.

The Roman law, which called for immediate section upon the body of a woman pregnant near term and dying suddenly, to save the

child, still holds, and in the writer's observation, three cases have arisen where this procedure was clearly indicated. Caution must be observed not to promise the ultimate survival of the child for, in some of these cases, the disease which ends the mother's life may render impossible the continued life and growth of the infant. In abdominal or other ectopic pregnancy, section is clearly indicated.

By whom shall delivery by abdominal section be performed?

The best results will be obtained when these operations are done in well-equipped maternity hospitals and by obstetricians. Neither the general surgeon nor the gynecologist has sufficient experience in pregnancy and parturition to make him a wise judge in deciding the important questions which these cases present. These patients call for far more than merely technical skill. A thorough knowledge of the pathology of pregnancy and labor, not only in the mother, but in the fœtus, is necessary for an intelligent choice of the variety of operation and the time at which it should be performed. Improvement in obstetric teaching and the development of maternity hospitals are gradually producing competent obstetricians, and such should deal with these cases.

It may not be without interest to allude briefly to the writer's experience. These cases came from an obstetric service in a large city and were operated upon in a small maternity hospital where the facilities of operation, while practically adequate, were not those of a luxuriously appointed surgical ampitheatre. These cases cover a period during which obstetric surgery was developing in this country, and therefore represent what may fairly be taken as an average.

The indications for operation embraced the field of obstetric pathology outlined in the preceding paragraphs.

The operations consisted of 129 classic cæsarean sections; 50 hysterectomies in which the stump was dropped and the abdomen closed without drainage; 32 Porro operations in which the stump was fastened by a clamp in the lower end of the abdominal incision; 3 extirpations of the uterus, and 2 sections, performed at the moment of maternal death — a total of 216 operations. These cases may again be divided into those that were in fair condition at the time of delivery with no fatal disease of the viscera and apparently uninfected by sepsis, and those which were at the time of delivery infected or suffering from some fatal disease affecting the important viscera. Of the former cases in good condition, there were 151, with one maternal death — a maternal mortality rate of 0.066. Of those cases that were infected and in bad condition, there were 60, with 16 deaths — a mortality rate of 26 plus per cent; the mortality of the entire series being 8 per cent.

The one case of death in those in good condition occurred from peritonitis caused by the bacillus proteus vulgaris. Bacteriological examination of suture material, dressings, and instruments failed to disclose the source of infection.

With the other fatal cases the toxæmia of pregnancy in its various phases was the cause of death in by far the greater number of cases. Degenerative conditions of the heart muscle, kidney, and liver were the principal visceral lesions in these cases. Among those dying of infection the number was relatively but a small proportion of the whole and, of these infections, pulmonary infection by the pneumococcus or the mixed infection of catarrhal pneumonia and acute pulmonary tubercular infection were the principal causes of death.

These patients were many of them brought by ambulance from tenements and were in various stages of exhaustion and infection. In many of them there was no time for adequate preparation. As regards the fœtus, there was no fœtal mortality in any case in which the fœtus was in good condition at the time of operation, and those fœtal deaths which occurred were the result of previous attempts at delivery or infection or malformation. Of especial interest to the writer are twenty-four cases of placenta prævia without a maternal death.

DIAPHRAGMATIC HERNIA

By OTTO J. SEIBERT, M.D., Cincinnati, Ohio

IF we carefully review the literature on diaphragmatic hernia we will readily find that this condition is not nearly so rare as has heretofore been considered. A diaphragmatic hernia has always been regarded as a surgical curiosity, perhaps chiefly because the condition has rarely been diagnosticated prior to operation or post-mortem examination. In a review of some 250 cases by Leichtenstein (1) in 1897, in only 5 cases was the diagnosis made before death.

If we consider the anatomical development of the diaphragm and the relation it bears to the abdomen and the viscera, it will seem almost obvious that hernia of this type should be just as common as other abdominal hernia. The diagnosis has heretofore been difficult because of the lack of external manifestations and definite physical signs. It has frequently been found while operating for some entirely different cause, but most often at necropsy, where death may have been due to other causes or directly to the hernia (i.e., strangulation or incarceration of the stomach or gut, or to intrathoracic pressure).

Diaphragmatic hernia may be divided into three distinct types:

True hernia. Those having a distinct sac. These may be either congenital or traumatic.

False hernia. Those without a sac. Most of these are traumatic.

Eventration. This is not a hernia in the strict sense of the term, but a doming or thinning out, or the entire absence of a part of the diaphragm.

In view of the pathology of this condition, certain signs in the examination of the chest, such as displacement of the organs of the chest, dullness on percussion, gurgling, etc., should be of value in making a diagnosis especially in conjunction with the subjective symptoms. However, these signs have on some occasions only confused and have led to other diagnoses, such as pleuritic effusion. O'Dwyer (2), of New York, in 1890 reported a case of this kind, finding a diaphragmatic hernia of the small bowel while operating supposedly for a pleuritic effusion in a child 3½ years old. The following day he operated for the cure of the hernia but the child died soon after the operation. In recent years, however, the X-ray has been the means of diagnosticating the condition prior to operation or autopsy, and through it diaphragmatic hernia will in the future, I believe, become more and more a definite surgical condition, rather than remain a surgical curiosity. A brief review of the literature of some of the more interesting cases or series of cases, will, I believe, not be amiss.

As early as 1852 Mr. Lawrence (3) reported to the London Pathological Society a case of large eventration found at autopsy on a man who had died of pneumonia. In 1861 Hillier (4) reported to the same society, a case of diaphragmatic hernia of the small intestine found at autopsy in a child 3½ years old that had died apparently from intrathoracic pressure. In the *Bulletin of the Anatomical Society* of Paris (5) for the year 1863 is found a report of a case in which autopsy showed that death had been due to strangulation of a diaphragmatic hernia of the large bowel. In 1907 Gordon (6) of British Columbia, operated on a man 33 years old for what he thought was a pyloric stenosis, and found the entire stomach in the chest-cavity. A gastrojejunostomy was done after replacing the stomach in the abdomen; death, however, followed three days later. No attempt was made to close the enlarged diaphragmatic opening. In 1897 Cordier (7), of Kansas City, did an emergency operation for an acute bowel obstruction but was not able to locate the obstruction until after death, at which time he found the entire stomach and large bowel strangulated in the chest-cavity through an opening in the diaphragm, 3 inches in diameter. Death was caused by the strangulation. In 1914 Binnie (8) stated that there were only two cases of cures on record.

In 1915 Robert Kienboeck (9) presented a rather extensive classified review of the German literature, which in brief is as follows:

A. Cases where autopsy showed death to have been due to strangulation of bowel or stomach through diaphragm. There were 11 left-sided false hernias; 2 left-sided true hernias; 1 left-sided rupture of the diaphragm.

B. Cases where autopsy showed death to be due to strangulation of stomach with perforation into (*a*) the thorax — 3 left-sided false hernias; (*b*) the abdomen — 1 left-sided true hernia and 1 enlarged œsophageal opening with split in diaphragm.

C. Cases simulating gastric ulcer or pyloric stenosis. Death due to other causes. Eight false hernias and 2 true hernias.

D. Cases diagnosticated *intra vitam* and confirmed at autopsy. One eventration, 3 hernias.

E. One case coming to operation with large opening in the diaphragm. Stomach partially in the chest-cavity. Reposition of stomach and closure of diaphragmatic opening, resulting in clinical cure.

Perhaps the most recent report of a cure of this interesting condition is that of Balfour (10), in January, 1916, of a case from the Mayo Clinic, Rochester, Minnesota. A tentative diagnosis of hernia had been made prior to the X-ray examination and later confirmed by the X-ray and this in turn at operation, at which time a radical cure was effected. This case was apparently of traumatic origin, trauma having taken place 4 years previously. There was a large tear in the left half of the diaphragm allowing the protrusion of both stomach and bowel into the chest-cavity, causing the displacement of heart and lungs, giving rise to rather definite signs on chest examination.

The cases cited are perhaps only a small percentage of those already reported. However, in a review, even more extensive than the foregoing, two facts remain prominent; namely, the extremely small number of cases recognized prior to autopsy, and the still smaller number of cures effected. Diaphragmatic hernia will no longer remain a surgical curiosity as heretofore, but with the X-ray at hand will become an almost everyday finding. For this reason the diaphragm will in the future become a more frequented field for the surgeon. Each case bears with it different points of interest and is therefore, worthy of record. The history of a case, which I had occasion to operate upon early in December, 1915, was of especial interest from various points of view and is, in brief, as follows:

Mrs. D., age 68. Family history negative. Previous personal history: Although she has had more or less stomach trouble all her life, even in her early childhood, she has never had any real severe illness and has enjoyed comparatively good health. She has had four children and the confinement with each of these was a long, protracted one, the labor in each case lasting from 36 to 72 hours. From the first of these she dates her present trouble. This was about 36 years ago. From then on she began to have pain after eating with much discomfort, belching and sour stomach. She often vomited her entire meal, undigested, four or five hours after ingestion. In the last two years this train of symptoms has become exaggerated in every respect. The pain and distress after eating became more severe; seldom was she free from sour stomach or belching. Vomiting followed almost every meal and the vomitus was often of a brown color. In the last year the pain and discomfort after eating became so severe and the vomiting so regular that she became afraid to eat, although she always had a good appetite. She has lost approximately 35 pounds in weight in the last ten months.

On December 1, I advised her to come to the city for stomach analysis and X-ray examination. The physical examination at this time showed little except signs of great loss of weight. Although still a large woman the skin was loose and flabby. The heart and lungs were normal to auscultation and percussion. There was no displacement. Clinical diagnosis at this time was pyloric obstruction, in all probability due to a cancer. On December 2, having been prepared for a barium meal, she was sent to Dr. Charles Goosman for X-ray examination. This proved to be most interesting. Repeated attempts to get a shadow of the barium in the normal region of the stomach failed. However, shadows of the barium in what appeared to be the duodenum were shown, but these were rather far to the left. At last a large plate showed a large blotch of the barium in its extreme upper portion and on close examination it was found to be above the shadow of the diaphragm. This gave Dr. Goosman the idea that her trouble might be in the œsophagus and not in the stomach. Pictures through the chest were then taken. All of these showed what appeared to be the outline of the stomach above the

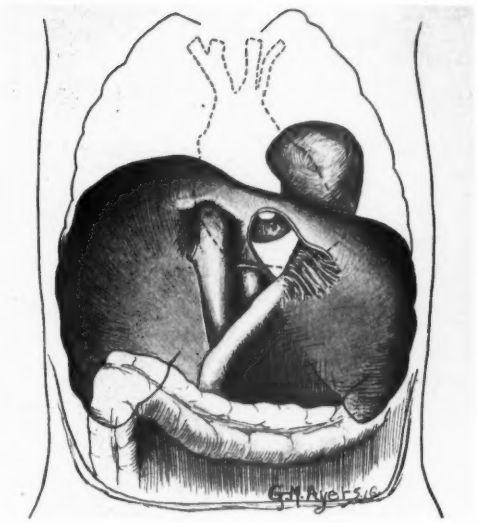


Fig. 1. Showing the entire stomach in the post mediastinum behind the heart, and dense fibrous bands binding the pylorus and first portion of the duodenum to the margin of the enlarged œsophageal opening.

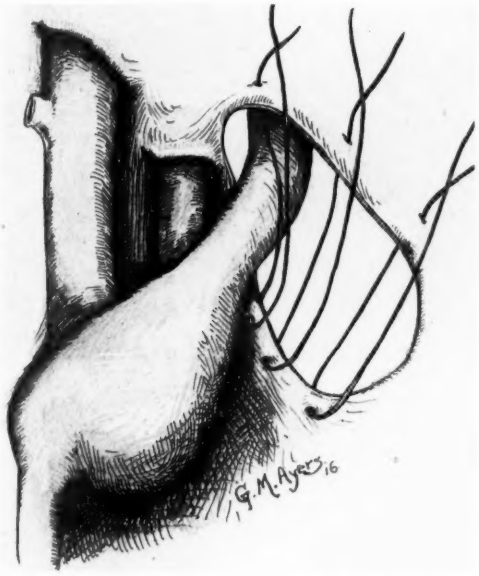


Fig. 2. Sutures in place through the hernia ring after fibrous bands had been cut and the stomach brought down into its normal position.

diaphragm, behind the heart, with the greater curvature upward and the pylorus to the left. Another examination two days later showed the same results. The stomach analysis proved to be normal in every respect except for a faint trace of blood. This I think was due to the stomach tube, which passed with difficulty after reaching a certain point.

On December 6, the abdomen was opened one inch to the left of the median line, directly below the margin of the ribs, and our X-ray diagnosis was readily confirmed. The duodenum was seen passing to the left and upward, directly to an opening in the diaphragm, large enough to admit the entire hand. The opening was to the left and posterior and proved to be the œsophageal opening. The entire stomach was found in the posterior mediastinum, directly behind the heart. An attempt was made to deliver the organ through the opening into the abdominal cavity, but this could not be done. It was found that dense fibrous bands of adhesions were holding the pylorus directly to the margin of the ring. These bands were so dense and firm that they had to be cut. After this was done the stomach could readily be pulled through into the abdomen. Interrupted sutures of heavy chromic catgut were then passed through the margins of the ring so as to almost entirely close it. This was accomplished with great difficulty because of the depth and angle of the field, and also because the movements of the diaphragm caused the liver constantly to slide over the ring, but chiefly because of the

Fig. 3. Sutures in ring tied, almost entirely closing the hernial opening.

Fig. 4. Roentgenogram, anteroposterior view (retouched). The stomach is to the left of the spine and appears to form a loop before the pylorus is reached. Just external to the pylorus is the shadow of the heart apex.

proximity of the aorta on the one side and the pericardium on the other. Before closing the abdomen I fixed the stomach to the abdominal wall with two chromic gut sutures. The patient has made a rather uneventful recovery and since the fourth day after the operation has enjoyed three big meals each day. The X-ray examination since the operation shows the entire stomach below the diaphragm but still somewhat higher than is normal. This I believe is due to an excessive doming of the diaphragm since the operation, the withdrawal of the stomach from the chest-cavity leaving a vacant space above it.

This case is rather unique in that, although the entire stomach was within the thorax, there was no displacement of the heart in any direction, nor was there any respiratory embarrassment as a possible result of pressure. It was apparently a congenital hernia, although the difficult labors in each confinement must not be overlooked as a possible etiological factor.

In the surgical treatment of these conditions the route of operative procedure is of course a subject of great importance. The two cases found on record by Binnie, as cured, were by the thoracic route. Heidenhein's case, in Kienboeck's review, as well as Balfour's case, was by the abdominal route. There are certain factors in the thoracic route which make it more hazardous and a more difficult operation. It is a much more extensive operation, requiring in many cases the resection of 3 or more ribs, and in most cases intratracheal anæsthesia; it is therefore a greater

Fig. 5. Roentgenogram, oblique view. The stomach is above the diaphram, the pylorus directed backward and downward, just anterior to the spine.

shock to the patient. In the abdominal route the liver greatly obstructs the field, but with suitable retractors this can be overcome. If the abdominal route is chosen I believe a sort of reverse Trendelenberg position (i.e., head high and pelvis low) will be of advantage in making the field more accessible. Whatever route is chosen the field is at best, a difficult one because of the proximity of the vital structures and any new point in the technique or new method of procedure will be valuable.

BIBLIOGRAPHY

1. Cordier, A. H. Ann. Surg., Phila., vol. xxvi.
2. O'Dwyer. Ann. Surg., Phila. vol. iii.
3. Lawrence. Lancet, Lond., 1852, ii.
4. Hillier. Lancet, Lond., 1861, i.
5. Bull. d. Soc. anat. de Par., vol. xxxviii.
6. Gordon. Ann. Surg., Phila., vol. xlv.
7. Cordier, A. H. Loc. cit.
8. Binnie. Manual of Operative Surgery, 1914.
9. Kienboeck, R. Fortschr. a. d. Geb. d. Roentgenstrahlen, xxi, 321.
10. Balfour, D. C. Ann. Surg., Phila., 1916, Jan.

CARCINOMATOUS DEGENERATION OF SEBACEOUS CYSTS

By ISADORE SEFF, M.D., F.A.C.S., New York
Adjunct Attending Surgeon, Beth Israel Hospital
AND
SAMUEL BERKOWITZ, M.D., New York
Surgeon, Out Patient Department, Beth Israel Hospital

ALTHOUGH Stelwagon (1) and Ziegler (2) state that sebaceous cysts rarely undergo epitheliomatous degeneration, Ricker and Schwalb (3) in a monograph on tumors of the skin reviewing the whole literature to date report on 43 cases of epitheliomatous degeneration of sebaceous cysts. The patients comprised 22 males and 16 females, but mention of the sex of the remainder was not made. Ricker and Schwalb found that heredity played an unimportant role. None of the cases was congenital. They could ascertain no one exciting cause; in one case trauma was mentioned as a predisposing cause, while in another menopause.

The ages of the patients varied; one patient was less than 20, 10 cases were 60 or more, and 29 were in the fourth to the sixth decade.

The tumors usually grew slowly. Most of them were the size of a walnut; some attained the size of a man's fist.

The predominant location of these tumors was the face. The tumors were located as follows: 8 had their origin in the meibomian glands of the lids; 6 were situated on the cheek; 7 originated from the skin of the nose; 3 from the skin of the forehead and upper lid; 7 from the back part of the scalp; 1 was situated in the skin at the inner angle of the eye; 1 from the skin of the back; 1 in the breast; 2 in the abdominal wall; and 1 in the upper extremity.

There is no mention of spontaneous disappearance of any tumor.

In 17 cases out of 41, ulceration apparently played an important part in the transition to epitheliomatous degeneration.

Bloodgood (4), in twenty years, observed about 300 cases of cancer in accessible regions of the body; such as the skin, subcutaneous tissue and mucous membranes of the mouth, tongue and lips. This author feels that proper surgery in the precancerous stage accomplishes 100 per cent cures.

In order to understand the pathological picture and clinical course of these growths a study of the embryology and histology of sebaceous glands is necessary.

Histologically, sebaceous glands or hair-follicle glands are racemose or acinous glands in close relation to the hair-follicles in the corium (1). They consist of a secretory portion and a duct. The basement membrane of the gland is surrounded by dense connective tissue arising from the hair-follicle or from the corium and contains the blood-vessels, nerves, and lymphatics. Upon the basement membrane are several layers of epithelial cells, the outermost resembling that of the rete malpighii. In this layer the cells are cylindrical and columnar; toward the inner portion they become larger and more or less cuboidal or polyhedral in shape.

According to MacCarthy (5) these glands originate from the "stratum germinativum" or germinating layer of the epidermis. Downward growth of these cells into the subcutaneous tissue is accompanied by differentiation into hair, sebaceous glands, etc. Each newly differentiated part retains a row of cells which corresponds to the embryonal stratum germinativum.

Pathologically, the ordinary sebaceous cyst is a retention cyst and arises from the occlusion of the orifice of a sebaceous gland on the surface of the skin. There being no outlet the secretion of the gland continues to collect in the interior and forms a cystic tumor. These are usually located on the face and scalp, but may occur on any part of the body.

In following the development of a sebaceous gland and the formation of a sebaceous cyst, one can readily conceive by proliferation of the epithelial cells lining the cyst, which corresponds to the embryonal stratum ger-

Fig. 1. Specimen No. 3572, subcutaneous epithelioma with keratohyaline degeneration. *A* Overlying skin, *B* normal sebaceous glands, *C* tumor.

Fig. 2. Specimen No. 4427, subcutaneous epithelioma basocellulare. This specimen shows the epithelial cell within the alveoli arranged in a pseudopapillary form.

minativum, it may undergo epitheliomatous degeneration. This proliferation may be due to irritation from within (as in Case 2), or as the result of ulceration of the cyst (Cases 1 and 3).

Within a period of twelve months we have had two very striking examples of the great value of early and complete removal of sebaceous cysts of the scalp that had undergone malignant degeneration. A third case seen by one of us (Seff), which terminated in general carcinomatosis and death of the patient showed the result of incomplete removal of the tumor.

CASE 1. J. S., male, age 51 years, admitted to the Beth Israel Hospital, November 17, 1912, with the following history. At the age of 20 he noticed a small growth on the right side of the head, which did not increase in size till he was 45 years of age, after which it rapidly enlarged. The growth became inflammed by continual irritation from combing his hair, and finally opened with the discharge of a serosanguineous fluid and foul smelling cheesy material. The tumor was removed and he was told that it was a sebaceous cyst. Within six years he had three recurrences of the tumor at the site of the first operation, and was told each time that the growth was a sebaceous cyst. His history on admission was a sfollows:

Nine months after the third removal of the growth, i.e., fifteen months before the patient came under our observation, he noticed a small growth in the same location, which gradually became larger and ulcerated. On examination there is a growth about the size of a butternut with a crater-like ulcerated appearance, situated over the right parietal eminence. The edges are indurated and the characteristic sebaceous material exudes from its surface. The anterior and posterior cervical glands are not palpable. A diagnosis was made of epitheliomatous degeneration of a sebaceous cyst. Under general anæsthesia the tumor with the healthy skin and subcutaneous tissue for a distance of about a quarter of an inch beyond the growth was excised. The edges of the wound were brought together and the wound healed by primary union.

Pathological report by Dr. E. Moschcowitz — specimen 3572 (Fig. 1).

Four sections were taken; from the tumor proper,

Fig. 3. Specimen No. 5076, recurrence of subcutaneous epithelioma basocellulare. This specimen shows the same arrangement as specimen No. 4427.

Fig. 4. Specimen No. 5236, epithelioma. A detailed description of this specimen is noted in the text (Case 3).

the tumor with overlying skin, from the ulcerated edge of the tumor and from the subcutaneous tissue beyond the margin of the growth.

The tumor is a subcutaneous epithelioma consisting of smaller and larger alveoli irregularly polygonal in shape, with only a small amount of stroma intervening. The alveoli are filled with epithelium which is basilar at the periphery, becoming more flattened and larger as we proceed to the central portion. The central portion of the alveolus is occupied by a necrotic finely granular material, shading gradually into the adjacent epithelium. Within this necrosed material are shadows of epithelial cells, some of which show faintly staining nuclei. These necrotic areas stain profusely with eosin. In some of these areas may be seen cross sections of the hair.

The epithelium is irregular, but regularly placed. There are numerous mitoses and an appreciable number of epithelial pearls. In that portion of the growth situated beneath the cutis there is a distinct zone of connective tissue intervening between the growth and the superficial epithelium. This is infiltrated with abundant round cells.

Diagnosis. Subcutaneous epithelioma with keratohyalin degeneration.

One year after operation the patient returned with a recurrence situated just beyond the margins of the healed incision. The posterior cervical glands were enlarged. The patient was impressed with the grave danger of allowing the growth to remain in the presence of the enlarged glands, but would not submit to another operation. The patient has since succumbed to general carcinomatosis.

From an analysis of this case it is evident that malignancy is apt to occur in a simple sebaceous cyst as a result of inflammation and continual irritation. Although the growth recurred four times, the lymphatic glands did not become palpable until the last recurrence.

CASE 2. Patient M. M., female, age 27 years, came under our observation at the Beth Israel Hospital Dispensary, November 21, 1913. Six months previously (May, 1913) she noticed a small irregular growth on the forehead which was slowly getting larger. This tumor was not painful or tender to touch, but annoyed her from a cosmetic standpoint. Her personal and family history had no bearing on the present condition. Examination revealed a small irregular swelling situated over the

glabella about the size of an almond, which was attached to the skin at one point. The tumor was movable over the underlying tissues. It was somewhat irregular in outline, but felt smooth. No submaxillary glands were palpable. A pre-operative diagnosis was made of a simple sebaceous cyst. Under local anæsthesia (novocaine 0.5 per cent) the tumor was easily shelled out, the wound closed and the patient advised to return periodically for observation. The tumor on cross section showed a granular, mulberry-like tissue enclosing sebaceous material in the center.

Pathological report by Dr. Eli Moschcowitz — specimen 4427 (Fig. 2).

The specimen represents an alveolated tumor. The alveoli vary markedly in size, and are irregular in shape and distribution. The microscopic field is apparently evenly divided between alveoli filled with well-staining epithelial cells and alveoli containing a small number of peripheral epithelial cells enclosing a mass of necrotic hyaline tissue.

1. Alveoli containing cells only: These alveoli are small. The epithelial cells within these alveoli are also small and arranged in a pseudo-papillary form. The nuclei are spherical, uniform in size and rich in chromatin. There is no tessellated arrangement or prickle cells.

2. Alveoli with cells containing hyaline necrotic material: These alveoli are as a rule much larger. Along the periphery are epithelial cells in greater or lesser thickness. These cells are spherical at the base, gradually taking a tessellated arrangement as we proceed toward the center, until they merge gradually into the necrosed hyaline tissue. Within the hyaline necrotic tissue, especially at the periphery, are shadows of epithelial cells often containing nuclei which are more or less faintly stained. The necrotic tissue is arranged in whorls, representing the early epithelial arrangement before degeneration takes place.

The connective-tissue stroma is small in amount, and reveals slight infiltration with round cells.

Diagnosis. Subcutaneous epithelioma basocellulare.

The patient, although advised to report at stated intervals, did not return until seven months after the tumor had been removed. There was then a recurrence at the primary site, which was about the size of a hazelnut. As a result of the experience with Case 1, we decided to make a more extensive removal of the surrounding tissue. Under local anæsthesia the growth was removed with the adjacent skin and subcutaneous tissue for a distance of a half inch. The subcutaneous tissue for a very short distance beyond the growth also had the same peculiar mulberry-like appearance as a cross section of the tumor.

The microscopic examination of specimen 5076, the recurrence, was reported by Dr. Moschcowitz to be identical in appearance with the original growth (Fig. 3).

The patient has been entirely free from any recurrence since the last excision of the tumor and the surrounding tissue, and is in good health, almost two years after the second operation.

CASE 3. A. M. E., male, age 47 years, was admitted to the Beth Israel Hospital, August 20, 1914. In May, 1914, he complained of a small growth about the size of a hazelnut located in the right temporal region. Repeated manipulation by his barber caused an inflammatory reaction, and the growth began to discharge a thick cheesy and foul smelling material. Two unsuccessful attempts were made by his family physician to remove the growth under local anæsthesia. It continued to discharge and grow larger. The patient was told that the growth was a sebaceous cyst. On examination we found a grayish white, lamellated, punched out ulcer about the size of a twenty-five cent piece, with indurated edges and a foul smelling flaky discharge. There were no pre-auricular nor cervical glands.

On August 27, the growth was excised under general anæsthesia, together with the skin and adjacent subcutaneous tissue for a little over an inch beyond the indurated edge of the ulcer. The wound healed by second intention. Recovery was uneventful.

Pathological report by Dr. Moschcowitz — specimen 5236 (Fig. 4.)

Specimen consists of many irregular alveoli filled with squamous epithelium, many of them intercommunicating. The center of many of these alveoli contain epithelial pearls; prickle cells are common. The stroma is small in quantity and consists of loose fibrous tissue infiltrated with many round cells. The circumference of this tumor is surrounded by squamous epithelium covered by a horny layer. Toward one side of the specimen this layer represents a perfectly normal skin. Around the rest of the circumference this layer shows great hypertrophy and dips into the stroma, communicating with many of the epitheliomatous alveoli. Nowhere is there evidence of ulceration.

Diagnosis. Epithelioma.

Fifteen months after operation the patient writes that there is no evidence of any recurrence or enlargement in the neck.

From the history we infer the former existence of a sebaceous cyst, although at the time the patient came under our observation, an epithelioma was readily diagnosed.

CONCLUSIONS

1. The origin of malignant changes in simple sebaceous cysts can readily be traced by a study of the embryology of the sebaceous glands.

2. Malignant degeneration of sebaceous cysts may occur at any period of life.

3. Local irritation is an important exciting factor in the malignant degeneration of a simple sebaceous cyst.

4. Removal of all sebaceous cysts, and more especially of those which are exposed to local irritation, as on the scalp, is strongly advised.

5. Removal becomes urgent in all sebaceous cysts which are rapidly increasing in size even if the local glands are not enlarged.

6. All excised sebaceous cysts should be examined microscopically.

7. Early and wide excision of the skin and subcutaneous tissue beyond the infiltrated or ulcerated edges of a sebaceous cyst which has undergone malignant degeneration offers a complete cure.

REFERENCES

1. STELWAGON. Treatise on Diseases of the Skin, 1905, p. 953.
2. ZIEGLER. Lehrbuch der Speziellen Pathologischen Anatomie, 1906, p. 545.
3. RICKER and SCHWALB. Die Geschwuelste der Hautdruesen, 1914.
4. BLOODGOOD. Boston M. & S. J., 1913, Nov. 27, 792.
5. MACCARTHY. Surg., Gynec. Obst., 1913, xvii, 445.

FOLLICULAR ODONTOMATA OF THE SUPERIOR MAXILLA

A CONSIDERATION OF INTRANASAL DRAINAGE FOLLOWING ORAL REMOVAL

BY CARL W. WALDRON, M.B., D.D.S., TORONTO, CANADA

THE question of the relative merits of oral or of nasal drainage in the surgical treatment of suppurative disease of the maxillary sinus has been one of long-standing difference of opinion. In a personal observation of more than 50 cases occurring in the service of Dr. S. J. Crowe at the Johns Hopkins Hospital, both at operation and during the post-operative course, the great advantages of intranasal drainage were apparent. When chronic maxillary sinusitis is unaccompanied by disease of the frontal or ethmoidal sinuses, the modified Caldwell-Luc operation is followed by rapid recovery and cessation of discharge. Thus the long-drawn-out post-operative course of oral drainage is avoided. The frequent painful dressings — the dread of which is considerable — and the insertion of gutta-percha plugs, etc., are unnecessary. If of dental origin, the offending peri-apical area as well as the pulp chamber and canals must be treated surgically or the tooth extracted. In no cases was there evidence of ill effects upon the nasal mucosa following this treatment, aside from temporary swelling lasting but a few days.

The excellent results following this method of treatment suggested that follicular odontomata involving the maxillary sinus, might be also treated in a like manner. Here there is no question of post-operative infection of the nasal mucosa, recovery is usually prompt, and post-operative treatments are not painful.

Dean has reported a case of compound follicular odontoma drained through the antrum into the nose and the external opening closed. Aside from this instance, the treatment generally adopted is that of oral drainage.

TECHNIQUE

The technique varies with the individual case, but usually follows that of the Caldwell-Luc operation. A horizontal incision is made through the alveolar mucous membrane well up toward the reflection of the mucous membrane and extending from the anterior to the posterior border of the tumor. Care is taken to preserve the mucous membrane intact and uninjured, making vertical incisions if necessary. The cyst-walls are completely removed from the surrounding bone. The maxillary sinus may then be incised if it has not already been opened in the dissection. A large opening is then made from the cavity into the inferior meatus of the nose anteriorly. Through this opening a curved clamp may be passed from the anterior nares into the cavity to grasp an iodoform gauze cigarette drain which is in-

Fig. 1. Root cyst involving the left maxillary sinus, Case 1.

serted through the oral incision. The gauze, which extends some two inches past the protective covering, may be moistened with hydrogen peroxide and lubricated with sterile vaseline. It is lightly packed against the walls of the cavity, maintaining in place any mucous membrane flaps which may have been preserved. The oral incision is closed with interrupted fine catgut sutures. The drain should be removed from the nose in 24 to 48 hours. This may be followed by slight bleeding. A few post-operative nasal irrigations may be advisable.

This method of closure has been most successful, the incisions healing *per primam*. In none of the cases of maxillary sinusitis did the wound re-open as is reported by Dean, who for this reason has substituted silkworm-gut sutures tied over rubber tubing. The excellent union is no doubt due to the fact that the incision is made at the reflection of the mucous membrane, which is at a considerably higher level than that described in textbooks. At this level the submucous tissue is greater in amount and therefore more easily approximated. In one instance following the removal of an extensive odontoma, the anterior end of the oral incision reopened, communicating with the floor of the nose (Case 3). Attempt will be made to close this at a later date.

CASE REPORTS

CASE 1. R. A., female, age 26, complained of a swelling of one year's duration beneath the left eye. The enlargement had been gradual and unaccompanied by pain. There was no history of chronic nasal discharge and the nasal examination was negative. In addition to the tumor, which was firm and crepitant and situated above the cuspid, bicuspid, and first molar teeth on the upper left side, examination of the mouth showed the absence of the upper left first bicuspid. The patient did not know whether it had erupted and had been extracted or not. The roentgenogram (Fig. 1) did not reveal the missing tooth, nor was it found at operation, the tumor being a root-cyst. It was removed as described under technique. The post-operative course was short, requiring practically no treatment.

CASE 2. E. C., male, age 21, had a dentigerous cyst operated upon three years previously and the incision had been kept open externally and irrigated for two years before it closed. One month before presenting himself, there had been acute pain, swelling, and rupture followed by a discharging sinus in the left cheek. There was some nasal discharge. Roentgenogram (Fig. 2) showed a tumor and infection of the maxillary sinus. Operation disclosed a large odontoma involving a considerable portion of the sinus. The tumor and the diseased mucous membrane of the maxillary sinus were removed, intranasal drainage established in the usual manner, and the oral incision closed with catgut. The sinus in the cheek, with a portion of the scar of the previous operation, was excised and closed with fine silk. The post-operative course was uncomplicated.

CASE 3. M. B., age 30, complained of a lump in her right cheek of six months' duration and of somewhat rapid growth. This had appeared during the latter part of pregnancy, which accounted for her delay in presenting herself for treatment. The growth had been slightly tender, but was unaccompanied by pain. Examination showed a large fluctuant swelling in the right superior maxilla, measuring about 5 x 5 cm., and extending from the right second molar to the left central region. There were many carious roots present and the right central incisor was missing. The floor of the nose and the inferior turbinate were displaced upward and medially and there was a small perforation of the septum. The roentgenogram (Fig. 3) showed a mass in the right maxillary region and the unerupted incisor. The Wassermann reaction was negative. At operation the cyst was found to extend to the posterior limits of the maxillary sinus,

Fig. 2. Recurrent cystic odontoma and sinusitis involving the left maxillary sinus. Case 2.

Fig. 3. Extensive odontoma involving the right maxillary sinus, hard palate and floor of the nose. The right central incisor from which the cyst had arisen is seen above the left central and right lateral incisors. Case 3.

destroying a large portion of its anterior and lateral bony walls. Anteriorly, it extended beneath the floor of the nose and vomer to the left side. The imperfectly developed incisor was located high up beneath the vomer and removed, the cyst-wall was dissected free with considerable difficulty, and removed. A large cavity remained, which was drained by removing the part of the inferior meatal wall and opening into the floor of the nose. The oral incisions were closed with catgut. On account of the extent of the cavity, packing was continued for several weeks, along with irrigations of potassium permanganate solution and salt solution. Three months later the deformity had practically disappeared, there was no discomfort or discharge, and the maxillary sinus was clear on transillumination.

CONCLUSIONS

1. Odontomata of the superior maxilla which involve the maxillary sinus to any extent are best treated by nasal drainage, the oral incision being completely closed following the removal of the cyst-walls.

2. By this procedure, the post-operative course is greatly shortened, the discomfort, pain, and dread of the repeated oral dressings are avoided.

3. Any ill effects upon the nasal mucosa are negligible, the swelling and irritation following this treatment being of short duration.

REFERENCE

1. Dean. Ann. Otol., Rhin., & Laryngol., 1913, xxii. 1078.

DEPARTMENT OF TECHNIQUE

AN OPERATION FOR THE CORRECTION OF DEFORMITY FOLLOWING CHOPART'S AMPUTATION OF THE FOOT[1]

By JOSEPH F. SMITH, M.D., Wausau, Wis.

CHOPART'S amputation of the foot is open to the well known objection that it removes the front of the foot in such a manner that the weight-bearing bone, the astragalus, is deprived of the support normally afforded it by the front of the foot and tends to be pushed forward against the cicatrix, producing painful tension and pressure. Besides, the tendo Achilles, unbalanced by the action of the dorsi-flexors, raises the heel, thus rotating the astragalus forward and tending to protrude the latter bone still more against the cicatrix. The elevation of the heel by the unopposed action of the tendo Achilles may even produce such marked backward tilting of the stump that the cicatrix becomes part of the weight-bearing surface, thus adding still more discomfort in any attempt to walk or bear weight upon the stump. Division of the tendo Achilles gives only temporary relief, and the procedure of implanting the dorsi-flexor tendons into the plantar flap does not always suffice to overcome the difficulty because in this implantation it is difficult to secure the necessary leverage to give the tendons action.

In spite of the objections to Chopart's amputation, it is still described in all the textbooks and is apparently the operation employed rather frequently in railway surgery.

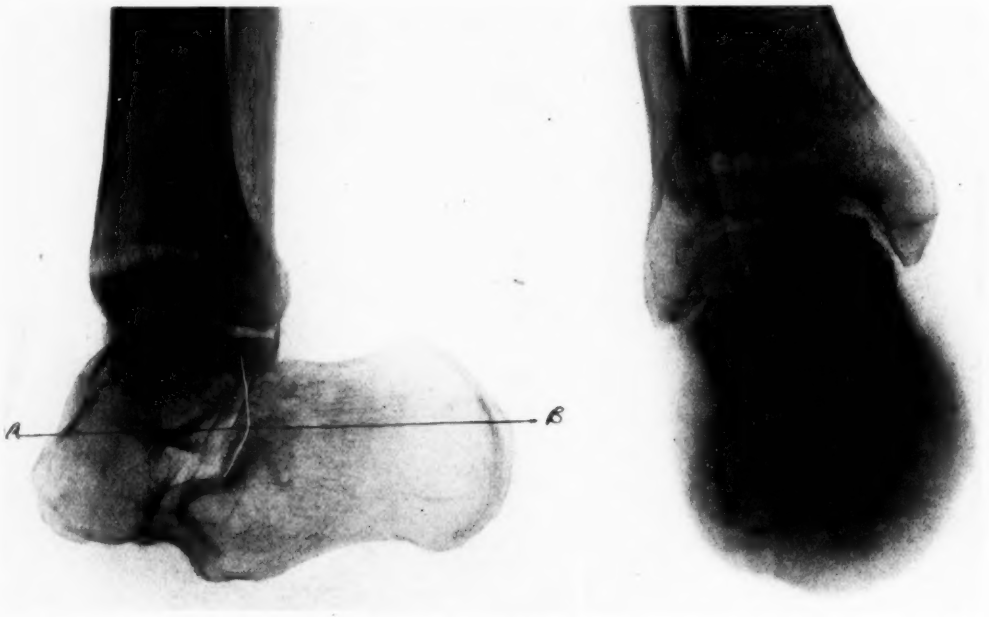


Fig. 1. X-ray print showing position of bones of stump after Chopart amputation. *A*--*B*, approximate line of incision through astragalus and os calcis for correction of deformity.

[1] Read before the Chicago Surgical Society, April 7, 1916.

Fig. 2. X-ray print showing position of bones of stump after correction.

Fig. 3. Photograph of stump after correction.

Following Chopart's amputation, Pirogoff's operation has frequently been done for the correction of the deformed and painful stump. The procedure herein described was carried out as a substitute for the Pirogoff operation in the correction of this condition and has not been found in the literature at hand, although it may have been previously described and carried out.

A. V., a railroad employe, came into the writer's care in the spring of 1915 on account of the condition described above, resulting from a Chopart amputation carried out for a crushing injury of the foot, sustained in railroad service about a year before. There was marked backward tilting of the stump, rotating the anterior surface downward so that the cicatrix formed part of the weight-bearing surface of the foot. The scar had become red and tender, and the man had been obliged to discard an artificial foot which he had been wearing. The X-ray plate showed marked forward rotation of the astragalus and tilting of the os calcis. It was impossible to ascertain whether or not any attempt had been made to anchor the dorsi flexors.

Instead of making a Pirogoff amputation the following procedure was carried out: A preliminary subcutaneous tenotomy of the tendo Achilles was done in order to overcome the upward traction on the os calcis. An incision on the outer aspect of the stump, parallel with and about an inch above the sole of the foot, was then made, the incision being carried down to the bones. After the flap had been reflected the os calcis and astragalus were sawed through along the lines A--B, Fig. 1, the upper portion of the os calcis and the lower portion of the head of the astragalus being freed and removed. The os calcis was then pushed forward under the astragalus so that the sawed surfaces were approximated, two holes were drilled and the bones secured in approximation by small bone nails. The wound was closed without drainage and inclosed in a light plaster cast which the patient wore for about six weeks. During the last two weeks the cast was removed daily for the application of light massage and passive motion.

At the end of three months the patient was able to wear a shoe, and since that time he has had a special shoe made which enables him to walk without the support of a cane or crutches and there has been, up to the present time (one year after operation), no complaint of pain and no recurrence of the deformity. The X-ray print, Fig. 2, shows the relation of the bones about six months after operation and the photograph, Fig. 3, shows the condition of the stump.

The advantages of this procedure over the Pirogoff amputation are the following:

1. It is much simpler and more easy of execution.
2. It preserves a larger area of the sole of the foot as a weight-bearing surface — a matter of great importance in these cases.
3. It preserves the ankle-joint and allows some degree of mobility to the stump.

DISCUSSION

DR. SAMUEL C. PLUMMER: In a case where the result is such as has been described, I should say that this operation is an improvement over a Pirogoff. I find that a Pirogoff amputation gives better results than an amputation at the junction of the lower and middle third of the leg, and Dr. Smith's operation I would regard as an improvement over the Pirogoff.

In the primary Chopart's amputation in this case we do not know whether the tendons on the dorsum of the foot are anchored or not. That I would consider an important point in Chopart's amputation. The unopposed action of the strong calf muscles attached to the tendo Achilles makes the anterior part of the foot bend downward, a kind of foot-drop, and bring pressure in a disadvantageous place, giving a result similar to what Dr. Smith obtained in this case before he operated on him; but if care is used to cut the dorsal tendons long enough and anchor them, a useful foot is obtained. In Chopart's amputation perfect control of the ankle is secured, and the patient gets a good functional result.

THE TREATMENT OF FRACTURES BY NAIL EXTENSION[1]

A Preliminary Report

By FREDERICK G. DYAS, M.D., Chicago

THE purpose of this paper is to make a preliminary report upon a series of cases treated by the nail extension known as Steinmann's method. The rapid development of the treatment of fractures and the bewildering rapidity with which new methods have been proposed within the past few years prove that the treatment of fractures is still in the developmental stage, and also demonstrates a renewed interest in this subject which roentgenology has brought about. If one may take Hoffa's statement as correct, that two-thirds of all invalidism is due to fractures, it is only fitting that a subject of such great economic importance should receive a proportionate share of attention.

Possibly the greatest interest in the operative treatment of unreduced fractures was stimulated by Lane. He leads that school which believes in an immediate complete anatomic restitution by open operation. The opposite school is led by Lucas Championniere, who believes that fixation of the fragments is not the first consideration, but preservation of function, this to be obtained by immediate mobilization and massage. As Steinmann has pointed out, each of these extremes is probably wrong, the ideal method being one which would include the good features of the early anatomic restitution and also mobilization of neighboring joints.

It is unnecessary to enumerate the vast number of methods used in the closed treatment of fractures. This subject may be dismissed with the observation that in many cases these old time-honored methods suffice to bring about good functional and anatomic results. The open operation which has literally been done to death in the last five years, especially in the hands of those who are not equipped either by training or environment to properly execute the technique involved in a precedure in which the element of infection is so great a hazard, requires only the statement, which I believe will receive the support of every experienced surgeon, that open operation must necessarily carry with it the danger of infection. Infection is frequently disastrous to the limb and often to the life of the patient. Therefore, open operation must be strictly reserved for that class of cases which is not amenable to other methods of treatment.

As Anschuetz observed, the nail extension of Steinmann is to be regarded in the light of a compromise measure between the frequently inefficient closed method and the hazardous open operation. The nail extension method was not original with Steinmann, who got his idea from the Malgaigne hooks so familiar in the pages of textbooks on surgery. This apparatus resembled nothing so much as a pair of ice tongs. Heinecke later invented an instrument which was quite similar in the blades, handles, and direction of pull to an obstetric forceps.

Codivilla in 1903 used an extension by means of plaster of Paris which answered well in many cases, but the tendency of the plaster of Paris was to produce a pressure necrosis.

From these methods Steinmann developed his procedure which he described as a method of extension which exerts a continuous traction exclusively by the aid of nails or screws which are driven either in or through the bone; whenever possible through the lower fragment. The original method was to drive a nail transversely through the lower fragment. This later was modified and two nails were used, one on each side being partially driven through.

The method of the introduction of the nail has been modified at various times. First the hole was drilled through the bone and the nail introduced through this drill hole. Another method was by preparing a nail with a square head which could be received into a brace and bored through exactly as a carpenter might with a brace and bit. This method is probably the best. However, it is quite possible to introduce the nail in the first manner by simply driving it through with the hammer.

Various types of nails have been used both by Steinmann and other operators, but experience has shown that the simple round nail with the sharp point answers every purpose. A special extension apparatus to be applied to the nail itself was devised by Steinmann, but the copper wire loop is quite as useful.

The point of introduction of the nail is of great importance. It is a cardinal principle in the treatment of fractures to postpone operative procedures until the inflammatory reaction or hæmatoma has at least partially subsided. This

[1] Read before the Chicago Surgical Society, May 5, 1916. (For discussion see page 491.)

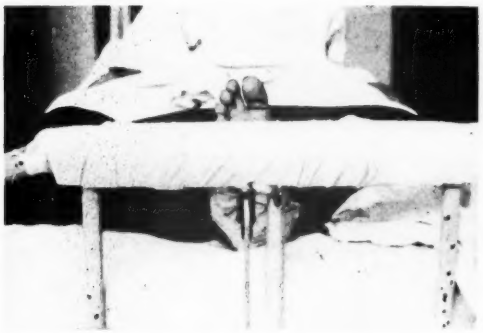


Fig. 1. Showing patient in bed, with weight attached to nail through os calcis.

holds true equally well for the nail extension because the introduction of the nail necessarily converts a simple into a compound type of fracture, and adds a foreign body. Therefore, in selecting the point for the introduction of the nail avoid if possible areas in which the soft parts have been traumatized and endeavor to utilize a portion of the bone which will not invade the medullary cavity. A situation close to the epiphyseal line is ideal except in the case of children and young adults in which epiphyseal ossification is incomplete. Furthermore, it is desirable to avoid injury to the joint capsule, which can usually be done by a consideration of the anatomy of the parts before introducing the nail.

The technique of the procedure is as follows: The skin is disinfected in the usual way. A small tenotomy incision is made down to the bone. Usually it is possible to select a site in which the bone is almost subcutaneous. The edges of the small incision are held apart by suitable retractors, the nail grasped in a heavy forceps is introduced through the tenotomy incision until it comes in contact with the resisting bone. The point of the nail is then given a suitable direction and forced through either by the hammer, the hand drill, or an electric motor. It is a good plan to have an assistant make pressure upon the opposite side of the bone with a wooden block covered by sterile linen to receive the shock of the hammer blows or the drill force. When the skin is seen to be elevated upon the opposite side a second small incision is made and the nail forced through further until an equal part protrudes upon each side of the bone. A collodion dressing is then put upon each wound. This is covered by sterile dressings, a sterile copper wire loop attached and, finally, this held in place by a sterile roller bandage.

Fig. 2. Showing patient in bed and weight applied for fracture of upper part of leg.

In our work this procedure has always been carried out under general anæsthesia. However, Steinmann, Anschuetz, and others report success with local anæsthesia, it being claimed that the only pain arises from the soft parts and periosteum.

Traction is then applied to the wire loop by means of a rope which is run through a pulley and a suitable weight attached, the amount of traction being controlled by frequent X-ray pictures. The direction of the traction can always be modified in such a manner as to exert the pull in a line continuous with the long axis of the fragment involved.

It is unnecessary to take up in detail the various situations in which a nail may be introduced. Suffice it to say that it can be used both in the upper and lower extremities. However, its chief field for use is in the lower extremity, because of the necessity of overcoming the shortening coincident upon the contraction of the heavy muscles of the thigh and leg.

The nail may also be used as a lever. This may be accomplished in one of two ways: For instance, in outward rotation of the lower extremity in fractures of the neck of the femur in which suitable inward rotation cannot be obtained. A nail driven into the great trochanter of the femur in a line parallel to the long axis of the

Fig. 3. Roentgenograms of Case 1 before and after application of nail extension for fracture of the right tibia and fibula.

Fig. 4. Roentgenograms of Case 2 showing position of fragments before application of nail extension and after.

neck of the femur and attached to a rope and weight running through a pulley, will tend to bring about and maintain overcorrection of the outward rotation.

Another method of using the nail as a lever is by hanging a weight on one or the other end of the protruding nail, thereby bringing about rotation in the direction desired. The duration of the traction is governed by the amount of correction of the pre-existing deformity. The optimum time is eighteen to twenty-one days. During that period a certain degree of pressure necrosis takes place, and this is usually more than enough time for the correction of the overriding of the fragments if sufficient weight has been applied. The pressure necrosis makes the removal of the nail easy, because of the increased caliber of the nail hole. The nail may remain *in situ*, however, for a considerably longer period of time, depending upon the judgment of the surgeon. However, the danger of infection necessarily increases with the duration of time. One case was reported in which because of the intensity of the traction the nail cut through the os calcis, in which it had been introduced too near the plantar surface, exactly as a dull knife would cut through butter. The nail was removed, no infection took place, and healing occurred without complications.

The intensity of the traction is determined by the progress with which the deformity is overcome. Ordinarily the discomfort resulting from any traction necessary to overcome the deformity is not great and speedily diminishes.

Lateral dislocation of the fragments may be treated with the extension in place by means of a loop of adhesive passed around the offending fragment and attached to a weight and pulley. Dislocation of the fragments in the longitudinal direction with complete separation of the fractured ends is possible because of the great traction exerted and must be carefully watched by the roentgen control.

It is perfectly possible with the nail extension to keep up functional treatment. This is a great point in favor of this method. Another advantage is in the treatment of compound fractures; because of the fact that the nail is introduced frequently at a point rather remote from the place of fracture it is possible to begin the treatment before the infection has subsided, thus gaining much time. Furthermore, it gives perfect access to the wound and thereby permits of frequent dressings. It is especially indicated in those types of fracture which are not recent and which are complicated by considerable overriding. The longest time at which the method has been used for this class of cases is in one reported by Anschuetz, in which the nail extension was applied to an ununited fracture 142 days after the accident, and a good functional and anatomic result was secured. In alcoholics and demented individuals it has also the advantage over many methods that it cannot be removed by the patient.

Among its disadvantages may be mentioned, first, the danger of infection. However, as the nail is frequently introduced through the os calcis, a bone which has no medullary cavity and

Fig. 5. Roentgenograms of Case 3 showing fracture of both legs before and after application of nail extension.

which, because of that fact, is hard to infect, the danger from that source in fractures of the leg is very slight. It is true that the danger increases with the introduction of the nail in the long, hollow bones, but if the precautions outlined by Steinmann are borne in mind this is relatively slight.

A second objection is the apparent brutality of the method. This is altogether theoretical and not real. Our experiences with a number of cases so far have demonstrated the fact that there is no more discomfort with the nail extension than with the Buck's extension, in many cases not as much. It is true that fatalities have resulted from this method, as from any other open method of fracture treatment, but the proportion of infections resulting from the nail extension as compared to the radical open operation we believe is very small.

Injuries to the soft parts may result from the introduction of the nail. In Case 3 of our series a nail perforated the posterior tibial artery. The incision was merely enlarged, the vessel picked up and ligated, and no unfavorable results occurred. This has occurred in a few reported cases, but in no instance was any permanent damage caused. Decubitus in the region of the nail hole has been reported but did not occur in any of our cases. Because of the intensity of the traction exerted it is possible to cause an overcorrection; that is, a separation of the fragments in a longitudinal direction. This may be controlled by frequent X-ray examinations and is easily reduced by lessening the amount of traction. The enormous traction also may be utilized for the lengthening of the soft parts where contraction has resulted from improper reduction and immobilization at the time of the injury. This is a great help in the treatment of old fractures.

Lateral dislocation is frequently overcome simply by the traction in the direction of the long axis of the limb, the tendency being for displaced fragments to fall into position when the intensity of the traction is sufficient to overcome the overriding.

It has been argued by some that the method delays union because of the tendency to separate the fragments. This is a purely theoretical objection because the traction is released as soon as the deformity is overcome and a permanent fixation dressing, such as a plaster cast, is immediately adjusted. We have not observed this in our cases.

Among the advantages of the method may be mentioned, first, that from a mechanical standpoint no other procedure can be expected to produce as strong traction. It is not more painful to the patient than less efficient methods. The traction is exerted directly upon one fragment and not merely upon the soft parts. The traction exerted by the familiar Buck's extension is exactly comparable to making traction upon the arm by pulling upon the coat sleeve. There is no direct pull upon the fragment.

In those fractures of long bones in which one fragment is very small, as in fractures of both bones of the leg near the ankle, it is of great advantage to apply traction in such a manner that only a small area is needed for the attachment of the traction apparatus. No plan has yet been devised which requires so little space for its

attachment as does the nail extension of Steinmann. This is of further importance from the fact that it permits free access to open wounds in compound fractures.

I wish to refer to a few case histories of patients treated in Cook County Hospital by this method.

CASE 1. The patient, male, suffered a fracture of the right tibia and fibula about a hand's breadth above the lower articular surface of the tibia, also a fracture of the internal maleolus. The fracture of the tibia was spiral and there was an overriding of the fragments of about an inch and a half. Repeated attempts at reduction under anæsthesia by various methods failed to reduce the fragments.

December 18, 1915, under ether anæsthesia and most careful asepsis a small tenotomy incision was made over the os calcis on its inner side. At this point a wire nail six inches long was driven through the bone transversely to its long axis, and at a point where the traction when applied would exert a pull on the lower fragment of the tibia, bringing it into alignment with the upper fragment. The nail protruded about two inches on each side of the wound. The wound was sealed with collodion and a sterile dressing applied. A copper wire loop was now attached to each end of the nail and extension made by means of a rope and pulley attached to this copper wire loop.

Traction was kept up for eighteen days, at which time the nail was removed, the roentgenogram showing complete reduction of the overriding. There was a little lateral displacement. A plaster cast was applied for three weeks more, at the end of which time the patient left the hospital with a splendid functional result and no shortening. There was no infection and the patient complained of no pain (Fig. 3).

CASE 2. On December 18, 1915, a patient presented himself at the County Hospital with a fracture of both bones of the right leg at about the junction of the lower and middle thirds. There was overriding of the fragments of about one inch. Two attempts were made under ether anæsthesia to reduce the deformity but were unavailing.

On December 23 under ether anæsthesia and careful asepsis a large wire nail was driven transversely through the os calcis after making a small tenotomy incision on each side. A wooden block covered by a sterile towel was braced against the opposite side from which the nail was introduced in order to take up the shock caused by the hammer blows. The nail was introduced so that an equal amount protruded on each side of the leg. The wound was then sealed with collodion and a sterile dressing applied. A copper wire loop was attached and held in place with a roller bandage.

The traction was left on for three weeks, at the end of which time the roentgenogram showed a perfect anatomic reduction. The nail was removed, the wound sealed with collodion, and a plaster cast applied for three weeks more. At the end of this time it was removed, and examination showed a strongly united bone. There was no infection in this case and the patient complained of no pain (Fig. 4).

CASE 3. A fifteen-year-old girl jumped from the third-story window of the County Hospital and sustained a fracture of both bones of both legs (Fig. 5). On the right side the fracture was compound. On the left side there was a separation of the lower epiphysis of the tibia. This girl was very much below par mentally and at the time of her attempt at suicide she was being treated for some drug habit. For two weeks subsequent to her injury she was treated by placing both legs in fracture boxes and dressing the wound daily. She would allow no attempt to be made at reduction. Consent was obtained from her parents to use the nail extension.

She was anæsthetized and the nail introduced in the usual way on the side of the compound fracture. Upon the opposite side an assistant was allowed to introduce the nail but missed the bone and drove it through the plantar fascia and periosteum, as was shown by an X-ray examination at a later time. Considerable trouble was experienced with this girl who complained of suffering great pain in both legs at the point of entrance of the nails, and color was lent to her complaint when the X-ray revealed one nail in the plantar fascia. This nail was then removed and no further attempt made to apply the nail extension on that leg. However, by coaxing and bribes she was finally induced to allow the traction to be made upon the right leg. The nail remained in place for forty-one days upon this side because of the fact that there were days upon which she would allow no weight to be attached to the rope. Upon other days she would allow a weight of three or four bricks, depending upon her humor. The wound at the site of the compound fracture healed kindly, the roentgenogram showed a complete reduction of the over-riding of the fragments, and the patient obtained a splendid functional result upon this side.

On the left side we were able by anæsthetizing her again to get the fragments into fairly good shape and hold them by means of a cast. The cast was allowed to remain on for four weeks on each side.

The girl now has two functionating limbs. Upon the side on which the nail extension was used there is no apparent deviation from the normal. Upon the opposite side slight deformity is present but she will undoubtedly be able to walk without a limp. In this particular case I believe there is no other way by which this fracture could have been so successfully treated.

CASE 4. A man twenty-seven years of age came to the County Hospital in January 1916. He had just spent four weeks in another hospital under treatment for fracture of the middle of the femur with overriding. This was treated in the ordinary way by a simple Buck's extension. A roentgenogram showed after four weeks that there was no reduction of the deformity, and the patient presented himself for treatment.

He was an intelligent man and it was explained to him that he had the choice of two methods of treatment; one the open operation with the bone transplant, or traction by nail extension. After some urging he consented to have the fracture treated by the nail extension method. He was anæsthetized and the lower end of the femur was prepared in the usual way. A small tenotomy incision was made low down over the external condyle at a point where the bone is almost subcutaneous. The nail was driven through until it emerged through the internal condyle. The wound was closed with a collodion dressing, a wire loop applied, and traction made with the limb resting upon a double inclined plane in such a manner that the line of traction was in a direct line with the long axis of the femur. In order to bring this about a piece of two-by-four was made fast to the foot of the bed on the same side as the fractured limb. A cross arm was nailed upon this and a pulley attached to the cross arm about a foot from the main piece. This enabled him to lie in bed with the limb in a position of moderate abduction, as this position is most comfortable. A weight of five and sometimes six bricks was attached for three weeks. The patient at first complained of some pain in the region of the fracture. It was noted in a skiagram made at the time of his admission that there was considerable callus at the point of fracture and an overriding of about an inch.

The pain soon subsided and the patient expressed himself as being more comfortable than he had previously been with the Buck's extension applied.

At the end of three weeks the nail was removed, the roentgenogram having shown that the overriding had been overcome. The lower extremity was then put up in a cast reaching from the axilla down to the toes and taking in the opposite limb as far as the knee. At the expiration of six weeks this cast was removed and it was found that the patient had complete bony union at the site of the fracture with no deformity. Measurement showed a shortening of less than half an inch. There was no infection at any time and the patient did not complain of any severe pain.

CASE 5. A male, aged thirty-five, sustained a comminuted fracture of the middle of the tibia with about an inch and a half overriding of the fragments. An attempt at reduction was made by attaching a rope to a plaster cast which had been applied to the foot and a weight attached to the rope. X-ray examination at the end of ten days showed no reduction of the deformity.

At that time, under ether anæsthesia, a nail was driven through the os calcis and a weight attached in the manner already described. At the end of sixteen days a roentgenogram showed that the deformity was practically entirely overcome, except that there was a little backward bending. This was easily corrected by putting a pad under the convex portion of the bone. The nail was removed and the limb put up in a plaster cast. Union has not yet occurred.

CONCLUSIONS

Advantages. 1. It is less dangerous than the radical open operation.

2. It enables the surgeon to exert the maximum amount of traction while using the minimum area for the attachment of the traction apparatus.

3. It will bring about a reduction of the deformity in old cases where other methods fail.

4. The technique is not difficult and can be mastered by anyone. Therefore the method is practical and can be used by the entire profession.

5. It gives access to wounds in compound fractures, permits of frequent dressings, and does away with unclean, infected fixation apparatus.

Disadvantages 1. Apparent brutality of the procedure. This is not real, however, as the patients suffer no more by this traction than by any other method.

2. Danger of infection. This is less than the danger of an open, radical operation.

3. Hæmorrhage. This may occur but can always be readily controlled by enlarging the incision and tying off the bleeding point.

CONTINUAL STOMACH LAVAGE AND CONTINUOUS HYPODERMOCLYSIS IN PERITONITIS, PERSISTENT VOMITING WITH DEHYDRATION, AND DILATED STOMACH

WITH A DESCRIPTION OF A MODIFIED STOMACH TUBE[1]

BY ALLEN B. KANAVEL, M.D., CHICAGO

THE separate or combined use of continual stomach lavage and continuous hypodermoclysis in the dehydration and toxæmia incident to peritonitis has proved itself of such signal benefit that it would seem to be worthy of wider appreciation. It has also been used with great satisfaction in persistent vomiting of any type, in dilated stomach after operation, and in similar states, while the continuous hypodermoclysis in addition to being used in combination with the gastric lavage may be used in dehydration and toxæmia from any cause. To make the procedure available certain changes in the ordinary technique have been devised.

STOMACH LAVAGE

For surgical purposes a stomach tube modified from the Einhorn and Rehfuss types has been devised. This modification is necessary since we wish a tube that can be inserted in the stomach and left in position days if necessary; moreover the tube should be one that can be introduced without the active co-operation of the patient, since it should be available even though the patient be nauseated and vomiting continually or be still anæsthetized.

The tube and its carrier are constructed as follows: The bulb is of the same size as the Rehfuss bulb except that the lumen of exit is larger and it is so constructed that it is impossible for the wire carrier to slip out. The rubber tubing is of the same size as the Rehfuss tube but only 30 inches long, being attached to a second heavier tube 25 inches long by a screw lock. A carrier of piano wire is made to fit the first tube so that it can be introduced without difficulty. The second tube is attached after the removal of the carrier and the contents of the stomach aspirated or siphoned off.

If the patient will swallow the tube, the lumen

[1]Read before the Chicago Surgical Society, May 11, 1916. (For discussion see page 491).

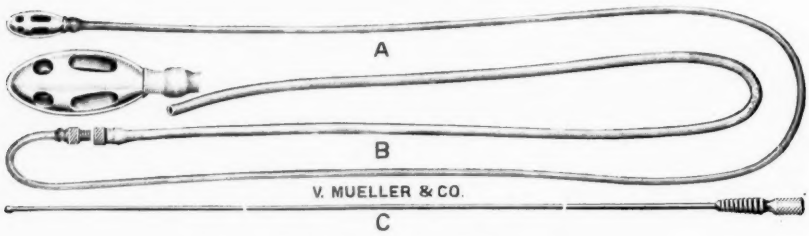


Fig. 1. Stomach lavage tube, bulb, and wire carrier.

of exit of the bulb being larger than the Rehfuss tube, the stomach contents can be aspirated with greater freedom and the mucus interferes less. This latter is of considerable importance in post-operative lavage when the mucus is generally considerable and interferes even with this tube at times. It will be seen that the bulb is so constructed that the point of the wire carrier cannot slip out of the bulb and injure the stomach. Owing to the shortening of the rubber tubing, there is less probability of the collapse of the tube upon suction and there is less difficulty in removing the carrier. This latter procedure is also aided by having the patient throw his head back thus lessening the sharp angle in the tube.

The tube described has proved of signal benefit in the vomiting of peritonitis or persistent vomiting from any cause as well as being of great aid in the routine examination of stomach contents for diagnosis. In the former instance the tube is either introduced by the surgeon, or is swallowed by the patient. It is then attached to the chin by a piece of adhesive plaster and may be left in for days. In the regurgitation incident to peritonitis, the stomach contents are aspirated every half hour to an hour and at regular intervals the stomach is washed out by injecting soda solution, or other liquid, through the tube and aspirating it. Between the washings the end of the rubber tube attached is placed in a basin with the end covered by fluid so that a continuous siphonage takes place. The retention of the tube is without discomfort, while the absence of stomach distention and vomiting gives the greatest relief to those distressed patients.

Fluid may be left in the stomach or medication given if desired. In one patient with peritonitis who was apparently moribund, the tube was kept in the stomach four days and the patient did not vomit after the treatment was begun, although he had been regurgitating large amounts previously. In addition to being used in peritonitis cases it has been used in persistent vomiting from any cause, as paralytic ileus, gastritis, toxæmic vomiting, etc. In such patients after washing the stomach for a day or two small amounts of liquid food are introduced, and if subsequent suction shows that the food is being absorbed, or is passing the pylorus, feeding is increased. Thus without discomfort to the patient we give food at the earliest possible moment.

If the tube passes the pylorus, as it may do upon the resumption of the normal stomach peristalsis, the duodenal contents are then aspirated which may be of benefit in some cases. It has occurred to me that it might be possible to carry the tube through a gastro-enterostomy opening at the time of operation and thus aspirate intestinal contents or introduce food. I have not attempted this, however.

CONTINUOUS HYPODERMOCLYSIS

In patients suffering from dehydration from any cause or from toxæmia, the administration of large amounts of normal saline during several days has long been recognized as of great value. The administration of this at stated intervals, calling for the reinsertion of the hypodermoclysis needles, thus distressing the patient and entailing much work on the part of the surgeon has militated against its more common use. To obviate this the following technique has been satisfactory. The ordinary hypodermoclysis set has been used with the exception that the needles are much finer than are those commonly attached and provision made so that the solution can be shut off from either needle. The needle chosen is four inches in length, No. 20. The assistants are impressed with the fact that no pain must be given the patient either during the insertion of the needles or the administration of the solution. To obviate this the skin is blistered with a few drops of novocaine (½ per cent solution) using the finest hypodermic needle, then a few drops of the same solution is forced along the course we expect the

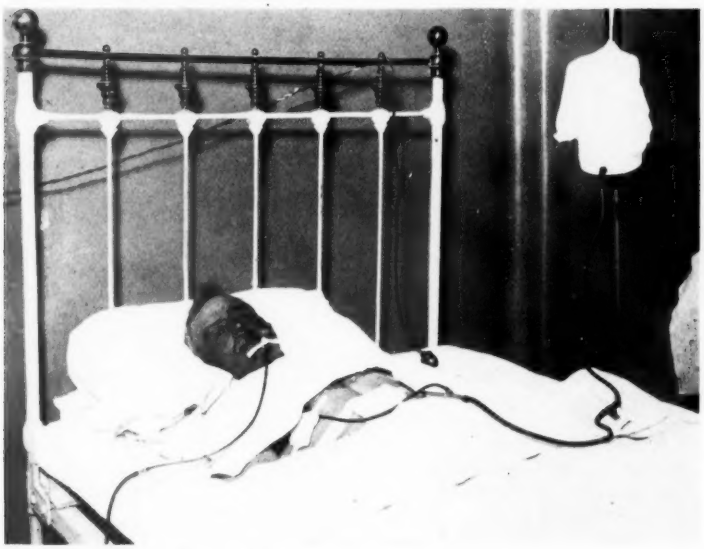


Fig. 2. Showing application of apparatus.

needle to follow in the deeper tissue. The point of a fine, sharp hypodermoclysis needle is then placed against the skin and gently rotated with firm pressure. This carries the needle in absolutely without pain. After being in place, the head is wrapped in gauze so that the flange does not touch the skin and cause pressure and the needle is fixed in position with adhesive plaster. The solution is kept warm by frequently refilling the can or using a sterile hot water bottle in the can. The solution is allowed to drop in slowly never distending the tissue to the point of pain. Whenever the patient says there is a sense of fullness, the rubber tube on that side is shut off.

In this manner we have frequently given continuous normal salt solution for three to four days with no discomfiture or ill consequences to the patient. We have used it in children without the slightest complaint on their part. Its use has become a routine in all cases of persistent vomiting and toxæmia as peritonitis, ileus, pernicious vomiting of pregnancy, toxic nephritis, septicæmia, etc. In debilitated patients we have inserted the needles and begun hypodermoclysis at the beginning of an operation and returned the patient to bed with the needles in place and continued the administration indefinitely. We have used it supplementary to rectal administration of tap water and in those cases where, owing to the nature of the operation, e.g., intestinal resection, this could not be used. As an example: Examination of the charts shows that in a seven year old child, Wesley Memorial Hospital, No. 56,931, suffering from paralytic ileus 4000 ccm. were given over three days, and in a patient with general peritonitis, Wesley Memorial Hospital No. 57,388, following appendicitis in a young man, 9000 ccm. were given over four days. And in another patient, Wesley Memorial Hospital No. 59,154, much dehydrated from persistent vomiting, 13000 ccm. were given in 44 hours.

In cases where the heart is growing weak there has been at times a tendency to water-logging of the tissue. Therefore such cases are watched carefully so that, on the one hand this will not occur and on the other, we shall not overload the circulation and strain the heart.

The benefit patients suffering from peritonitis have derived from the combined use of continual gastric lavage and continuous hypodermoclysis is far beyond that secured by any other procedure with which we have had experience.

THE USE OF ELECTRIC LIGHT AND HYPOCHLOROUS ACID IN THE TREATMENT OF WOUNDS

By GEORGE W. CRILE, M.D., F.A.C.S., Cleveland, Ohio

FOR some years the electric light has been utilized in the treatment of burns, and in the literature we find occasional mention of the efficiency of electric light treatment for obstinate ulcerating surfaces, such as varicose ulcers, etc. Apparently, however, the wide applicability of this treatment has not been recognized, if one may judge by the paucity of the literature under this heading. Chaput, writing in 1914, states that the wide usefulness of electric light "baths" was discovered by him during a dark season in which sun baths were unavailable. In many kinds of cases he therefore tried the effect of exposure to the light of a fifteen-candlepower electric lamp, applied daily or every other day for hourly periods. As a result of these trials, he found that "in the ordinary electric lamp we possess a simple, practical, economical, and very efficient means for treating obstinate ulcers, and infected and gangrenous sores." Chaput predicted also that this conception would find its application in the treatment of "certain complications of the wounds of war."

Last year at the American Ambulance in Paris, Dr. Winchester Dubouchet called my attention to the value of electric light in the treatment of infected wounds. Dr. Dubouchet used ordinary electric lamps, single or in clusters, with or without reflectors, the treatment in each case being continued night and day. We gave the method a trial on my service and secured so much better results than by the use of dressings that, upon the return of the Lakeside Unit from France, we introduced this treatment in Lakeside Hospital and observed its effect upon various types of wounds.

What the experiences of war had proved to military surgeons soon became obvious to us, i.e., that little if any advance in the treatment of infections had been made in many years. We soon realized also that the real reason for the efficiency of the electric light treatment lay in the fact that Nature's own method of promoting repair is thus produced artificially, as is demonstrated not only by Chaput's successful substitution of electric light for sun baths, but far more strikingly by the remarkable facility with which wounds heal in desert places. For example, in Arizona, where the air is dry and rare and the rays of the sun are direct and strong, the carcass of an animal does not readily decompose. In this region, tuberculosis is easily cured, and tubercular lesions of the skin and superficial parts heal rapidly.

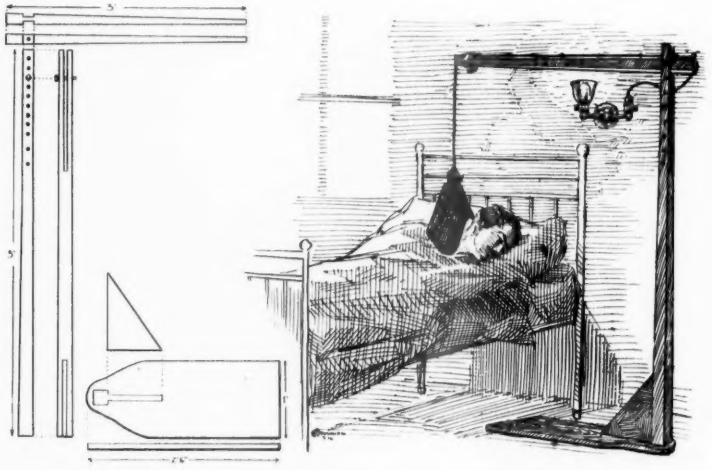


Fig. 1. The Fuller adjustable bracket for applying electric light treatment to wounds.

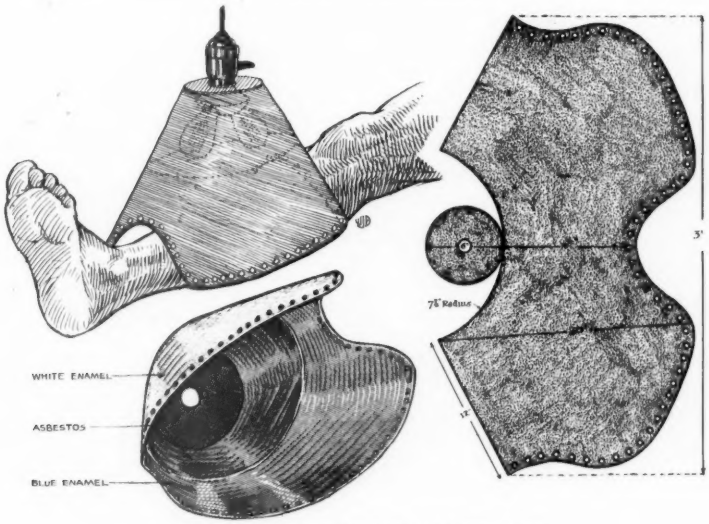


Fig. 2. The Bell metal hood for electric lamp.

Analysis of sunlight and of ordinary electric light show that they are practically identical. In view of these facts, although we have recognized the therapeutic value of the Finsen ray, the Coolidge tube, etc., we have been slow to appreciate that, by simply utilizing the radiance and warmth of the ordinary electric lamp, we may bring the dryness, the heat, and the light rays of the desert to the wound to promote its healing.

The omissions of dressings in itself is an important factor in the success of this method. Sir Berkeley Moynihan has stated that the average dressing of a suppurating wound is in effect a pus poultice. Indeed, until I observed the behavior of wounds exposed to the air it had not occurred to me that in dressed wounds the greater part of the discharge was due to the irritation of the dressing.

It is not my purpose here to discuss the theories which may explain the value of heliotherapy or electric light thermotherapy. These are sufficiently presented in current journals, especially those devoted to electrotherapy and radiology. Nor shall I present the chemical formulæ and reactions which indicate the reasons for the efficiency of hypochlorous acid as an antiseptic cleansing agent. These are fully discussed in articles by Dakin and Carrel. My purpose in this paper is to describe the manner in which we are applying electric light treatment and hypochlorous acid in a variety of cases. An apparatus devised by Miss Fuller and Dr. Bell of the Lakeside Hospital (Figs. 1 and 2), by which electric lamps placed in pasteboard cones or in metal hoods are suspended from an adjustable frame, has proved a practical and comfortable means for applying light treatment to wounds of the neck, chest, shoulder, arms or legs. For abdominal wounds, the lights may be suspended from a cradle. The amount of light and the proximity of the lamps to the wounds are governed by the comfort of the patient. For the necessary cleansing of the wounds, we use Dakin's solution[1] or Wright's solution.[2]

Osteomyelitis. In cases of osteomyelitis a temporary pack is placed over the wound immediately after operation to prevent oozing. After a few hours this is removed and the undressed wound is exposed to several electric light bulbs suspended under a cradle (Fig. 3). The bulbs are near enough to the wound to subject it to a comfortable warmth. Secretions from the wound are cleansed with Dakin's solution and, if coagulated serum develops, a hot pack with Wright's hypertonic solution, applied for half an hour or more, cleans up the field. In some cases the exposure to the electric light is continued both

[1] Dakin's Solution —

Dry sodium carbonate	200 gms.
Chlorinated lime	140 gms.
Tap water	10 litres

Mix and filter through cotton.
Add 40 grams boracic acid.

[2] Wright's Solution—

Sodium chloride	3 parts
Sodium citrate	1 part
Water	96 parts

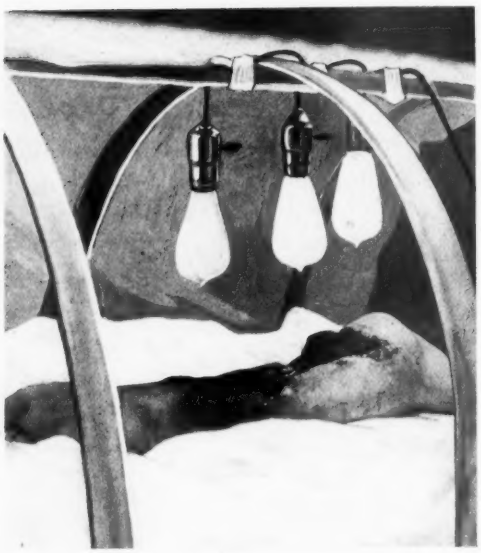


Fig. 3. Case of osteomyelitis under electric light treatment.

night and day. Aside from the hot pack and Dakin's solution, no other dressing or antiseptic is employed. Our experience with the electric light treatment in osteomyelitis has demonstrated three outstanding advantages: the wounds heal more rapidly; much less dead bone appears; the wound discharge is markedly decreased.

Open granulating wounds. That skin grafts do better without dressings is well known, but under exposure to electric light not only cases requiring skin graft but all open granulating surface wounds show increased healing power.

Open tuberculous abscesses. We find that during the first night it is best to pack a tuberculous abscess in order to establish an open wound. After this, these cases do well under hypochlorous acid cleansing, the X-ray being used also while the wound is wide open. We have found that many of these wounds may be sutured within five days, and that fairly good primary healing follows.

Deep drainage. In cases requiring gall-bladder, appendiceal, or pelvic drainage, we find that they progress well under intermittent exposure to electric light and that the patient is much more comfortable under the heat and light.

Cancer of the mouth. After the excision or cauterization of cancer of the mouth, hypochlorous acid is especially useful because it is a deodorant, and not an irritant or a poison.

Empyema. The malodorous properties of empyemata are splendidly controlled by the injection of hypochlorous acid.

Acute infections. In the treatment of acute infections of the joints and of the deeper soft parts, the combination of a continuous irrigation with Dakin's solution through multiple drainage tubes, with exposure to a cluster of electric lights produces excellent results. In severe acute cases, the drip irrigations should continue by night as well as by day. Wright's solution also is efficient in these cases.

Aseptic closed wounds. We have made a number of observations of the effect of exposure to electric light on aseptic closed wounds and have found that the patient was much more comfortable than with dressing, and that the wound healing was at least as rapid.

CONCLUSION

All living tissue attempts to encyst or to cast off foreign bodies of all kinds. No one would consider the advisability of putting a gauze dressing on a corneal ulcer, and yet the violent reaction of the eye to a foreign body differs in degree only—not in kind—from the reaction of living tissue to dressings anywhere. We know that we dare not pack gauze on suture lines, not drain fractures. We know that nails and screws cause the absorption of bone; that any aseptic wound with drainage discharges much fluid; that wounds roughly handled during operations discharge more fluid than clean cut wounds. We know how difficult it is to bury steel plates in bones; to bury heavy silk in aseptic wounds. From the benefits of dressings must be subtracted all the resultant ills—irritation and discharge, added necrosis, pain, and discomfort. Frequently changed hot dressings are more comfortable than plain dressings and perhaps produce less pus; but if applied too long, they tend to waterlog the tissue. Moreover, the wet hot pack gives no different quality of heat than does the electric light, and the heat from the electric light penetrates quite as readily as the heat from the hot pack.

Wounds heal best when infection is hindered or destroyed by the agent least harmful to the tissue and without the irritation of foreign bodies in the form of dressings. All these ends are served by the use of hypochlorous acid solution and by exposing the undressed wound to constant light and warmth.

THE APPLICATION OF THE SEWING MACHINE STITCH IN GASTRIC AND INTESTINAL ANASTOMOSES

By E. P. QUAIN, M.D., F.A.C.S., Bismarck, North Dakota

THE illustrations presented herewith demonstrate a needle devised by the writer for the purpose of applying a double interlocking suture in gastro-enterostomies and entero-enterostomies. The needle is threaded as shown in Fig. 1, and the other end of the catgut is fastened to a blunt straight needle. The needle is pushed far enough through the two structures about to be sutured, serosa-to-serosa fashion, so that the eye near the point clears the distal mucosa by about one-fourth inch. The straight needle with the other end of the catgut is now put through the catgut loop near the mucosa as in Fig. 2. The first needle is withdrawn and the stitch pulled tight.

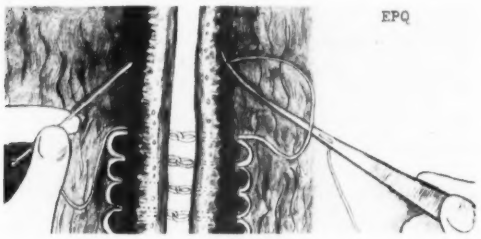


Fig. 1.

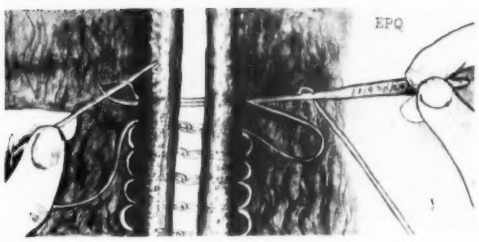


Fig. 2.

After the suture of the posterior edges of the anastomosis has been completed, the stitching is continued back along the anterior margins as shown in Fig. 3.

The two advantages gained over other methods of suture in gastric and intestinal anastomoses are: first, absolute hæmostasis, and second, saving of time.

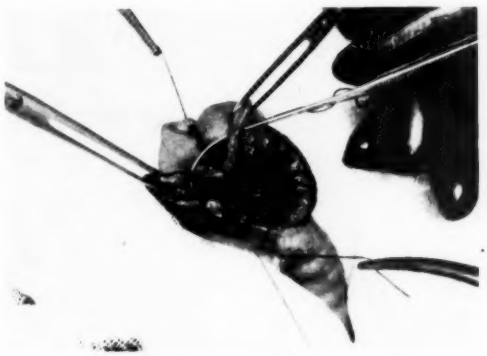


Fig. 3. Photograph showing anterior half of gastro-jejunostomy. The needle is passed inside the jejunum out through its serosa and then across to the gastric margin which is penetrated in reverse order. The suture loop is picked up with the other needle on the gastric mucosa as in Fig. 2. Pulling the two ends taut makes a firm serosa-to-serosa approximation.

A DETACHABLE APPLIANCE FOR THE CONVERSION OF THE OPERATING CYSTOSCOPE INTO A DOUBLE-CATHETERIZING INSTRUMENT

By P. S. PELOUZE, M.D., Philadelphia
Cystoscopist, Urological Department, Jefferson Medical College Hospital

WHEN one tries to pass two ureteral catheters through the Buerger operating cystoscope, which is the one most generally used in this country, he finds that they stick to each other, kink in the channel, and do various other things to promote failure. After a few such experiences, he realizes that the instrument was surely not intended for double catheterizations, and is compelled to resort to the instrument especially designed for such work. A study of these two instruments will show that, as far as the outer sheaths are concerned, there is really no essential difference, and, as regards the periscopes, the only important difference is that that of the double catheterizing instrument has a fixed fin to divide the unoccupied lumen of the sheath into two separate catheter channels.

Operating cystoscope with detachable fin by which instrument can be connected with double catheterizing cystoscope.

Usually the double catheterizing scope is purchased first, the necessity for operating arises, and the physician learns that he must buy an entire new instrument. The similarity in the outer sheaths makes a part of the investment appear unwarranted, but each periscope fits its own particular sheath, and there are no "universal fits."

To overcome some of these difficulties, I have devised a detachable separating fin which makes it possible to convert, in a moment's time, the operating cystoscope into a double catheterizing one that works equally as well as the one made for that purpose. This little appliance is so well illustrated in the accompanying cut that it needs no description.

Not only does it admirably fulfill the purpose for which it was made, but it increases the range of intravesical procedures at one passage of the instrument, a point very gratifying to most patients.

One field in which I have found it of particular value is that of separate renal function tests. During such a test, the study of the separate urines is of greatest value, and it is usually a simple matter to collect them. A number of disappointments in separate efficiency tests has shown me the futility of looking for accuracy in such tests by inserting No. 5 or 6 F catheters into both ureters. The leakage into the bladder during the test period is generally so great as to render the readings useless, as it is impossible to state positively from which kidney it came. On the other hand, if one collects his urines for study, withdraws the catheters, removes the fin, and inserts the tapering Garceau catheter into one ureter until it entirely fills its lumen, and collects the other kidney's urine from the bladder, there practically ceases to be a margin of error to consider.

The addition of this appliance to the operating cystoscope, in short, gives one all of the range of usefulness of two models and at a cost very little above the price of a single instrument. While this may not make a strong appeal to the manufacturers, it makes an eloquent one to the physician who starts out to buy an outfit for cystoscopic work. As previously stated, there are no "universal fits" with these instruments, which fact, unfortunately, makes it necessary to fit the attachment to each individual cystoscope.

TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

REGULAR MEETING, HELD MAY 5, 1916, WITH THE PRESIDENT, DR. SAMUEL C. PLUMMER, IN THE CHAIR

HYPERNEPHROMA OF THE LIVER

DR. CARL G. SWENSON presented a specimen of hypernephroma of the liver.

POST-OPERATIVE RESULTS OF SOME UNUSUAL CASES

DR. EMANUEL FRIEND read a paper entitled "Post-Operative Results of Some Unusual Surgical Cases," and exhibited patients.

CONTINUAL STOMACH LAVAGE AND CONTINUOUS HYPODERMOCLYSIS IN PERITONITIS, DEHYDRATION FROM VOMITING, AND ALLIED CONDITIONS

DR. ALLEN B. KANAVEL presented a paper entitled "Continuous Stomach Lavage and Continuous Hypodermoclysis in Peritonitis, Dehydration from Vomiting, and Allied Conditions." (See p. 483.)

DISCUSSION

DR. DANIEL N. EISENDRATH: Dr. Kanavel has presented an excellent idea because there is one factor in acute gastric dilatation (post-operative) that we are apt to overlook, and which this tube will help greatly in removing. Everyone has probably noticed in cases of acute dilatation that after you have washed out the stomach and have not given the patient a drop of water by mouth, inside of three or four hours there will be an accumulation of more or less fluid again. It took me quite a while to understand that this is due to hypersecretion from the gastric mucosa. There is very little or nothing said about this condition in the literature. It is a sort of gastrosuccorrhœa. It seems to me, a tube which is kept constantly in the stomach will help greatly, because, after the preliminary washing out, a suction tube will take care of the disagreeable hypersecretion.

There is one thing in this connection I would like to call attention to, which we have observed recently and have tried to control as much as possible, and that is the determination of the amount of carbon dioxide. Dr. Wright is working out the relation between acidosis and gastric dilatation. Many of these cases are instances of acidosis, and the moment we can control that we have greatly assisted in our control of the acute gastric dilatation.

THE USE OF NAIL EXTENSION IN FRACTURES

Dr. F. G. DYAS presented a paper on "The Use of Nail Extension in Fractures" (see p. 478), which was illustrated by numerous slides.

DISCUSSION

DR. KELLOGG SPEED: I would like to say a few words on this method because I have been using it for two years and have had 15 cases.

First of all, the copper wire loop has a peculiar history, and I may as well tell it to you. In the first case in which I used this method I asked an interne to get a wire loop and put it on the nail. He was not able to get picture wire which I asked him to get, but he found copper wire which he used instead, and it worked so well that we adopted it in subsequent cases. For the nail I have been using steel drill rod, five-sixths of an inch in diameter, cut off at the required length. The traction on the nail can be relieved, if the patient is distressed, by moving it and replacing it. The nail also controls the amount of rotation to either side in fractures of the femur when applied to the femur itself. The nail becomes loose in the os calcis in about 18 or 20 days.

We have had two cases of accident in connection with the nail in the hole. In one, in the third week, the patient getting tired of the traction, reached down and pulled the nail out, but the interne discovered this quickly and by injecting a small amount of iodine in the hole through the bone we avoided any infection.

The second case was brought to the operating room for the removal of a nail as it had become loose. In fractures of the femur, of which I have had but few cases, I have found the nail is not loose in three weeks. I use a much larger nail through the femur in such cases.

I have had one case with a result, after three weeks by traction from the femur, seemingly as good as that shown. The leg was put in a cast after that time and the fragments slipped back because the callus was not hard enough. In subsequent cases we found the results were better when treated for five weeks with a nail through the femur.

In the pictures Dr. Dyas has shown us, in one case I am sure that the nail was not put through the os calcis. That does not make any difference, because if the nail is pulled very hard it may pull through the os calcis and impinge on the heavy plantar fascia and plantar tissues which will hold just as well as bone will. This method has been tried by putting a nail not through the bone itself, but in the space in the tendo Achilles and in the space in the os calcis, and it works just as well.

The apparatus Dr. Dyas has shown you for foot-drop, it seems to me, is entirely unnecessary, because when the extension is applied to the os calcis there is absolutely no tendency for the anterior portion of the foot to drop down. At least, I have never seen it. The os calcis itself, on account of its cancellous structure, lacerates under this type of treatment, and the nail is easily inserted.

I want to say a word about the intensity of the traction in the knee and ankle. The separation that was apparent in some of these cases is due to the stretching of the joint-ligaments. That is not of a permanent character because after the traction is relieved the joint resumes its normal condition and there is no permanent damage done of which I know.

The results are not distinctly anatomical. I have never obtained a satisfactory X-ray picture of a case that showed anatomical reduction, but functionally the legs are brought into weight-bearing line and are very satisfactory.

Dr. William Fuller: I think that almost any method of treating fractures will answer the purpose sometimes. However, if we discuss "methods" their value cannot be correctly estimated, unless we at the same time specify the particular kind of fracture in which we would employ a particular method.

While the Lane bone plate has fallen into disfavor owing almost entirely to its misunderstood principles and its indiscriminate use by those who should know better, as well as by those who do not, I still believe that this device has a very distinct and an important place in the treatment of fractures.

Instead of the intelligent application of many other measures now at our disposal in fracture work they are entirely misunderstood and are made use of under conditions which are often without the slightest justification. Strenuous efforts at traction and extension are often made where such are not needed, just as they are of least and the last consideration when they are needed.

As one writer has said we individualize too little in our treatment of fractures. No measure yet described is without some value somewhere, but in order to decide just what procedure should be followed, a careful diagnosis should always be made and every indication accurately determined. Then if we select the particular measure or part thereof which is rightly called for and display intelligence and understanding in the use of whatever that may be, the end-results should be satisfactory.

The nail driven into bone for the purpose of traction, as described by Dr. Dyas tonight, and by others before this, may have a place in the treatment of fractures. But of all the maneuvers yet described I should not hesitate to give this one the last place, especially when used as a means of affording traction. It necessarily offers some difficulties in placing it exactly in the bone as desired; it is in reality an open operation; it is liable not to hold when great traction is made upon it; it establishes a communication between an unclean skin at one end of the nail, and a bone lesion surrounded by damaged soft parts at the other end; and what is of more importance than all other points combined is the use we can make of older and well-tried methods which call for no operative work and which hold just as well, perhaps better. But notwithstanding these objections, Dr. Dyas has shown that the nail can be advantageously used. The nail for purposes of extension, the Lane plate, the bone plug, the transplant, the screws, the wire, all have some merit, and can when judiciously employed be of service.

Surgeons have long hoped for a more rational means of treating fractures. That time will probably not come till the general medical man ceases altogether his efforts in this work, and when the general surgeon devotes more time and thought to it, and exercises the same care and consideration as he ordinarily employs elsewhere.

There are more malpractice suits brought against members of the profession for their failures to satisfy the public in the treatment of fractures than in all other work combined. Why is this? It is because other surgical work is not done as blindly, carelessly, and unscientifically, as is the treatment of fractures. In surgery of the head, of the thorax, and the abdomen, ample room, good exposure and abundant light are demanded. The end-results in the treatment of fractures will be no less so when we treat fractures on the same rational basis as is the rule in surgery in other parts of the body.

We cannot all agree with Dr. Dyas when he says that the nail sticking from the skin surface as he has shown here is as little likely to produce an infection as the open operation. The nail hole is virtually a drain track and we are familiar with some of the dangers attending these when located near clean wounds. Just how they can be less serious when made by a nail transfixing the broken limb and passing out to the surface to be occasionally toyed with as happened in one of Dr. Dyas' cases, is not clear.

In closing I would say that no device or measure should ever be used in the treatment of any fracture simply because it is new; but only when they have shown unmistakably that no other device or method can serve the purpose as well.

Dr. Daniel N. Eisendrath: I would take exception to Dr. Dyas' condemnation of the lack of value of Buck's extension. If properly applied, Buck's extension is of the greatest value. It can

not only be applied to the horizontal position but to the lower third of the femur with a double inclined plane.

As to Steinman's method, there are certain cases where it is of tremendous benefit and reports in the literature show that it has its value. There are certain cases of compound fracture or simple fractures, with extensive denudation of the skin, where the application of such a method as this is simple, it replaces everything else, where operation is almost out of question, and the application of adhesive plaster is out of question. There are cases in people with irritable skin where the application of adhesive plaster is simply impossible.

The picture of one case which Dr. Dyas showed us illustrates quite forcibly the frequency of spiral fractures and the impossibility of correcting these by ordinary traction. There are many more elements than ordinary traction, such as the interposition of muscle, the interposition of periosteum, and such factors, which we cannot overcome by simple traction with the Steinman method or with Buck's extension. We have in those cases to cut down to the bone and correct the fragments by manual reduction. If you remember the picture which Dr. Dyas showed of a bad spiral fracture with loose fragment, when he showed the after result, it looked as though I was mistaken about the Steinman method, that it was supplanted entirely by the open reduction, but when we saw the anteroposterior picture it confirmed our opinion that the Steinman method of reduction had not corrected the deformity as it should. However, this method has a field of usefulness and should be remembered in the treatment of fractures, but as a universal method we must be skeptical about accepting it.

Dr. John F. Golden: I take it, Dr. Dyas meant his method to be applied in a certain class of cases with a certain environment; that it is suitable in those cases where we have to decide between the open operation and the closed operation, and where we would not be satisfied perhaps with the closed operation. We should consider the results obtained by him in these cases and the fact that the patients recovered without infection, and the further fact that Dr. Speed has mentioned fifteen cases without infection. If this method can be resorted to without infection it should certainly meet with our commendation, but when we consider the danger of infection from that method in causing osteomyelitis, it would seem the open operation perhaps would not be any more dangerous. It is the results we should look after, and it seems it is more a method for the individual case than one to be commended generally.

Dr. E. C. Riebel: The method described by Dr. Dyas has its strict indication, and undoubtedly deserves a place among our methods. When we speak of the operative treatment of fractures we cover a great many procedures, and I have in mind particularly the leaving of foreign bodies. Even if a foreign body heals in, it may cause subsequent trouble. I placed some Lane plates in a case of fracture of the femur some years ago. The fracture was a transverse one, the man had a cerebral contusion and was violently delirious. This made it absolutely impossible to retain the fragments in place. There was so much overriding of the fragments that it was necessary to resort to the open operation. The plates healed in kindly without any reaction, and the man left the hospital at the end of eight weeks after open reduction and the introduction of the plates. He went back to his work and has been working for three years. I saw him about six weeks ago with a swollen knee-joint which showed the presence of fluid and extra-articular swelling on the inside a little above the internal condyle. In tapping the knee-joint I found a serous effusion, probably due to peri-articular irritation, and after making a small extra-articular incision I found the usual fluid, showing that there was a chronic osteomyelitis. After three years' time perfect union had apparently taken place, but the man developed this disagreeable feature which necessitated the removal of the plates.

The reason we do not get better results with treatment by adhesive plaster is because we usually do not watch our cases carefully. One distinct advantage of the Steinman extension is that the extension can be used with the joint in some flexed position, doing away with straight traction on the joint, and the uncomfortable stiffening which results from that method. The same advantages particularly in fractures of the leg may be obtained by using the apparatus of Hennequin or a modification of it. I have used adhesive plaster extension instead of the plaster-of-Paris shoe originally employed by Hennequin and can show just as good results by this method of extension as with the Steinman.

Dr. Frank E. Pierce: I do not want to criticize this method because I am frank to say I have not tried it. There have been a number of cases where I thought of trying it, but I have not found cases between those which I could not treat by external methods of extension, as by Buck's extension, and those which needed operation.

The point has been raised as to the relative value of Buck's extension and other means of external extension. I would suggest this: If surgeons would devote as much attention to the old methods, such as Buck's extension, as they do to some of these new methods the results would be equally as satisfactory. The main reason we have looked for so many new methods is because so much fault has been found with the technique of the old. The results have been bad because we have not given each individual case enough attention. In hospital work the tendency is to have an interne fix the fracture and adjust an extension splint, and the result is frequently bad. If personal attention is given these cases, and Buck's extension used, the results will be as good as if other means of extension were used, except where open operation is necessary.

DR. C. G. BUFORD: My experience with fractures has not been small. From the hysteria that has developed on the account of so-called improved methods in the treatment of fractures it might seem to those outside of surgical circles that fractures have been giving us a great amount of trouble and that we have been laden with damage suits. Such has not been my experience or my observation.

My methods have pretty generally been along the old plans of treatment, namely, attempts at simple reduction under anæsthesia when necessary and the use of Buck's extension in the extremities when indicated. Simple fixation appliances have been used early, and open or closed casts used as permanent dressings. I think I get as good results as can be obtained. I have no cripples running around, no complaints from the patients, and have never had a damage suit threatened connected with fractures. I rarely use the Lane plate or bone peg. When reductions are impossible and deformities are objectionable I usually do an open operation and approximate the fragments, closing without drainage. Once the fragments are in position it is easy to hold them there. It is the fragments that are not in position which make it difficult to retain them in their proper position. I do want it understood that the Lane plate and bone peg, like other good devices, have their places in surgery but since their introduction I believe as most of you here believe, that they invite too many operations and are used entirely too frequently. I have been amazed at the large number of plates and pegs reported from the services of men with a relatively small amount of work. I feel that the nail brought out by Dr. Dyas is a good thing in its place; it will certainly have its field of usefulness. I have personally never had occasion to use it.

The special note which I desire to sound is: Do open operations if you must but leave fewer and fewer foreign materials in the wound.

DR. DYAS (closing): I want to give Dr. Speed full credit for introducing this method in the treatment of fractures at the Cook County Hospital. He was the first man to use it, and with his permission I will say that when I began this work we endeavored to get a group of cases together which would enable us to make a report of some value by reason of the number of cases treated. He deserves full credit for the detailed technique which we have carried out in our work.

I knew my paper would be criticized, but if surgeons are absolutely satisfied with the way they are going along in treating fractures and try nothing new, they will never make any progress. I feel that our results have justified the work. It is our intention to treat further cases with this method so that we may obtain reliable information. We have not done any injury to any patient. We have not had infection in a single case. We have not had absolutely accurate anatomical results but we have had good functional results.

As to Buck's extension, I did not mean to condemn it to the extent that some of the speakers do, but it is perfectly true from a mechanical standpoint, that it is impossible, for any one to expect to apply as much traction by means of adhesive plaster to the skin as can be applied by a definite, exact traction apparatus, such as the nail and copper wire and pulley extension. Buck's extension has a wide field of usefulness and always will have. The method I have described is not intended to supplant anything, but it has its place with strict indications, and I think the functional results will justify the use of the method.

THE CORRELATION OF THE CIVIL AND MILITARY SURGEON

DR. JACOB FRANK read a paper on "The Correlation of the Civil and Military Surgeon."